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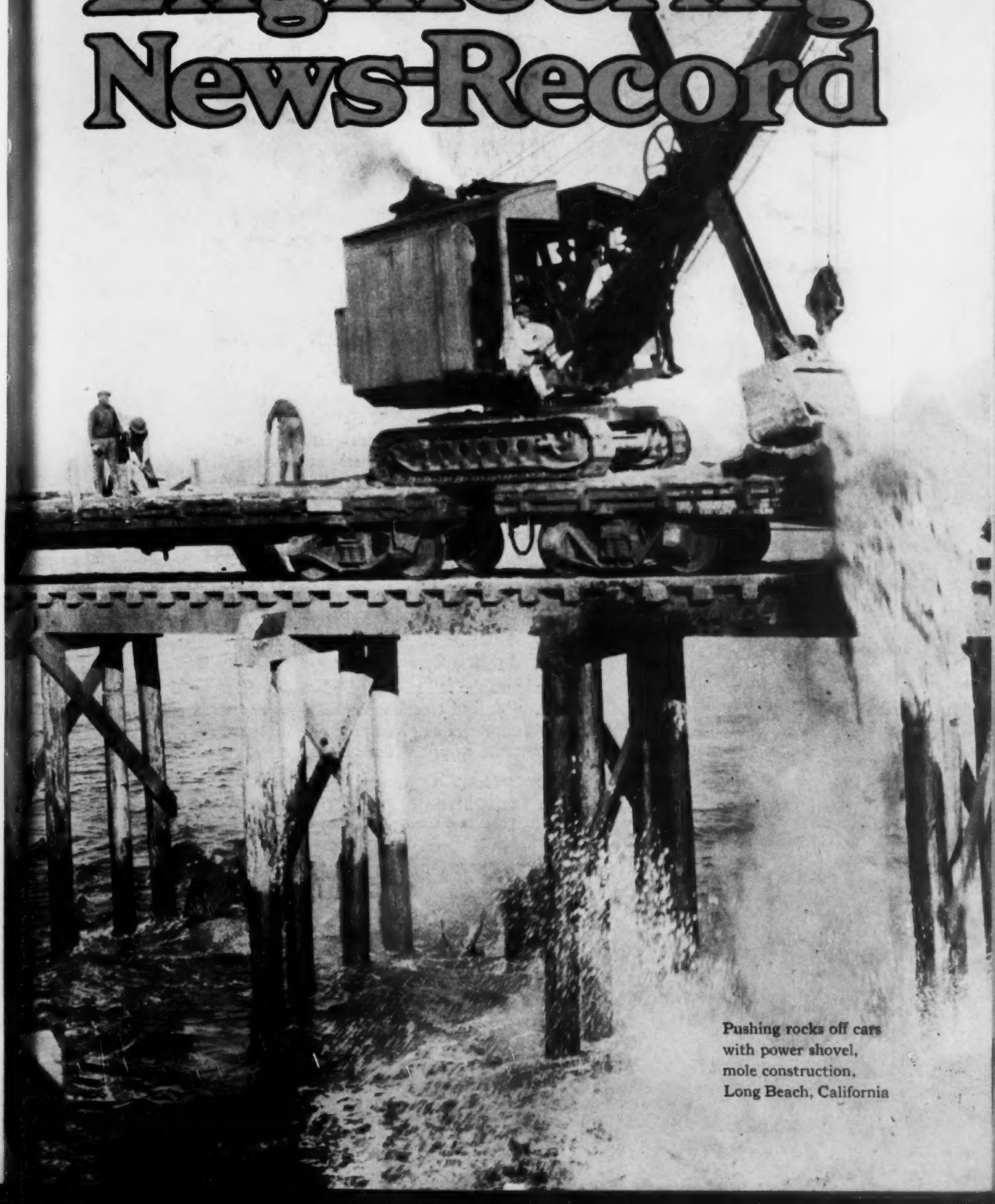
Engineering News-Record



Pushing rocks off cars with power shovel, mole construction, Long Beach, California

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

McGraw-Hill Publishing Co., Inc.
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FRANK C. WIGHT
Editor

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Engineering News-Record is a consolidation of *Engineering News* and *Engineering Record*, effected in 1917.

Engineering News was founded in 1874 by George H. Frost, as the *Engineer and Surveyor*, which title subsequently became the *Engineer, Architect and Surveyor*, then *Engineering News and American Railway Journal* and finally *Engineering News*, under the successive editorships of D. McN. Stauffer, Arthur M. Wellington and Charles Whiting Baker.

Engineering Record was established in 1877 by Henry C. Meyer as the *Plumber and Sanitary Engineer*. The name was subsequently changed to the *Sanitary Engineer, Engineering and Building Record* and, finally to *Engineering Record*. During his ownership of the paper, Mr. Meyer was directly responsible for the editorial policy. John M. Goodell became editor in 1902, and was succeeded by E. J. Mehren.

The Contractor was consolidated with *Engineering News-Record* in 1918.

E. J. Mehren became editor of *Engineering News-Record* at the time of the consolidation in 1917, and was succeeded by Frank C. Wight, Jan. 1, 1924.

The staff of *Engineering News-Record* consists of

New York: Frank C. Wight, *Editor;* M. N. Baker, F. E. Schmitt, C. S. Hill, J. W. Shaver, V. T. Boughton and W. G. Bowman.

Chicago: W. B. DeBerard, E. E. R. Tratman.

San Francisco: N. A. Bowers.

Power Shovels in Subways

DEVELOPMENT of an arch bracing specifically to permit power-shovel excavation is credited in this issue to the contractors building a part of the Flushing extension of one of the Brooklyn subways. It is anticipated that the right to do this will be disputed. There is precedent enough in past subway operations for both open bracing and power shovel excavation to beget a dispute over priority which would take a Philadelphia lawyer to decide. Providentially then, perhaps, it is on one of the contracts for the Broad St. subway in Philadelphia that precisely similar methods are used and have been announced as original. As said, there is precedent on previous subway work for arch bracing and power shovel excavation. In several of the rock cuts of the earlier subways the timbering or steel supports were so arranged as to permit the use below them of power shovels. No similar development in earth cuts, prior to the work described in this issue, has come to recollection. Also as far back as 1903 an arch bracing method was devised by James C. Meem, engineer for Frederick L. Cranford on his first subway work in Brooklyn, but was planned chiefly to obtain wider spacing for construction cars and not to permit power-shovel operation. It appears certain enough then that arch bracing, as described in this issue, specifically to give room for power-shovel excavation in earth cut is a recent development in subway construction methods. In fact, with the use of other power tools, it is the feature characterizing present-day subway working methods and differentiating them from the hand processes of older undertakings.

Sulphur in Rivet Steel

FAR-REACHING changes in the steel making industry should result from the findings as to the alleged harmful effect of sulphur on rivet steel, reported last week. Dr. George K. Burgess, chairman of the joint committee which is studying the effect of phosphorus and sulphur in steel, stated the final conclusions on the first section of the study cautiously but clearly. It is now the steel users' obligation to accept these conclusions with all possible dispatch and arrange their specifications and purchases accordingly, in order to make the results useful to the world. Dr. Burgess reports that soft steel of rivet grade may carry materially more sulphur than hitherto allowed, without affecting its quality. His charted summary shows that up to 0.06 per cent sulphur has no effect, while from 0.06 to 0.18 per cent it affects only one or two test properties. Recalling that the investigation was carefully planned to bring into the picture various possible forms of occurrence of sulphur, we must recognize that 0.06 per cent sulphur now has a clean bill of health and that we can probably go higher than 0.06 without concern, since the only property much affected, the Charpy notched-bar impact value, has not a very well defined correlation to most service uses. It is supposed to be a measure of brittleness, but for that very large range of uses in which tensile strength, elastic limit, elongation and reduction of area are satisfactory measures of toughness the meaning of the Charpy figure is quite unproved. Dr. Burgess says conservatively: "The sulphur present in commercial rivet steel up to at least 0.06 per cent is not detrimental." At least this conclusion merits prompt industrial utilization—for which, as already said, the immediate co-operation of the user is desirable.

A Peak Road Cost

MATERIAL road costs reach increasingly higher peaks so rapidly that the Los Angeles superhighway described in this issue may next season be outranked in cost in one or half a dozen communities now contemplating similar public roads improvements. There is a distinction in this California highway which however should be kept in mind when drawing comparisons. Its cost of $484,000 a mile is for straight-forward road construction. There were no considerable expenditures for unusual highway structure or for costly right of way; the money went for grading and paving. Both were heavy tasks as the description makes plain. Indeed one does not recall so heavy a grading operation

in so short a distance in any previous highway construction. Also to our recollection the pavement has nowhere been surpassed in sturdiness of design. These facts make the Cahuenga Pass road notable even among superhighways.

Engineering Education Corrects Itself

THE meeting of engineering educators at the university of Iowa two weeks ago was active and interesting. Apparently the investigation of engineering education under the Carnegie grant is beginning to show results, even though those results can hardly be codified at the present time. It was evident, however, that the self-investigating policy that Mr. Wickenden inaugurated is teaching every faculty a lot about itself that it would not have found out by other means. So far no cure-all is suggested, nor even a chronic disease to cure. It is evident that engineering education is by no means in as bad case as some of its products would have us believe. It can stand specific reform in specific places, and that is what the S. P. E. E. study will probably lead to. That anything radical will come out of it is extremely doubtful.

Why So?

THE Middle and Far West are much more friendly to the activated-sludge process of sewage treatment than is the East. Go up and down the Atlantic Coast and quite a ways inland and only a few plants of the kind, and those small, will be found. In the Middle West, there are the large installation at Milwaukee, two or three built or being built in the Chicago Sanitary District, of which one is very large, and a large one at Indianapolis. Texas has many plants of this type, including the two at Houston which for a number of years were the largest ones in operation anywhere in the world. California cities have been friendly to the process, as is witnessed by several plants, including the tri-city installation for Pasadena, South Pasadena and Alhambra, described in our issue of Oct. 29, 1925, p. 714, and the plant for a second group of three cities —Pomona, Claremont and La Verne—noted in our issue of July 1, p. 10. In Canada, the Province of Ontario has many activated-sludge plants. Why this process has found so much favor in some sections and so little in others is an interesting subject for speculation.

Conservative Minneapolis

DEFEAT of the proposed council-manager charter at Minneapolis on June 21 was so pronounced that it can be attributed to no one cause. The provision for a financial board of review, unfavorably noted in these columns June 10, p. 289, does not seem to have affected the voting much either way. The chances are that it lost more votes for the charter than it gained, because it is contrary to the idea of centralization of responsibility and because such an unusual charter provision presumably had few friends in a city which has voted down new charters seven times in the last thirty years. It would be interesting to see what Minneapolis voters would do at an election on a council-manager charter without either proportional representation to offend the ward-system worshippers or a board of financial review superior to the city council if set in motion by a mere handful of taxpayers to displease most of those informed on present trends in city government.

An Engineering Monument

JUST a week ago the Philadelphia-Camden bridge over the Delaware River was opened to traffic, and on the Fourth of July it was dedicated. With these events a noteworthy addition was made to the great structures of the world. Linked by chance with Philadelphia's anemic sesquicentennial exposition, the great bridge will live and serve long after this ephemeral show is forgotten. It is an engineering monument to public enterprise, to the compelling demands of a new age of intercommunication, and to the high ability of modern civil engineering.

The surging growth of highway communication needs which is causing us to build roads and to bridge uncrossed streams in great numbers has no more fitting single expression than the Philadelphia bridge. Railroad service long ago demanded a bridge over the Delaware near the city, but human transportation other than by rail remained so slow and circumscribed that even the expansive pressure of a great metropolis was insufficient to overcome the river's confining strength. When the motor vehicle shod mankind with seven-league boots, however, building a bridge became inevitable. That the states and cities were ready to take up the task at the appointed time is a fine testimonial to the evolution of community and intercommunity initiative. Again, it is praiseworthy that their financial foresight and thrift led them to ordain that present saving should pay off the cost of the undertaking by temporary toll operation, instead of piling the cost on the pyramiding structure of capitalized public service equipment.

But the bridge is worthy of admiration most of all as an embodiment of modern engineering skill. In excellence of technical efficiency and artistic form it will over hold high rank. Coming nearly fifty years after that pioneer undertaking, the Brooklyn bridge, it represents in a sense the concluding chapter of the book then begun. Roebling in the seventies and eighties built with much calculation and scientific design, it is true, but yet most largely with boldness to venture into unknown matters. In the forty-odd years since then, much discussion has waged over the strength of suspension bridges, and a great many gaps in definite knowledge have been pointed out. Almost to the last one, these gaps have been closed in the course of the work of the Delaware bridge engineers. They have given us almost complete certainty concerning the strength of cables—even the thirty-inch cylinders of wire which they had to build up—and of cellular steel towers, of anchorages and rope socketings. Their refined analyses of the bridge structure put us in position to know with great precision the strength of the intricate suspension structure under all contingencies, and to know also that all contingencies have been provided for in the structure as built. No changes in traffic conditions that can be foreseen even speculatively will impose undue burden on the bridge. So far, indeed, was the test work auxiliary to the bridge construction carried that its last item is not yet complete, or at least has not yet been reported—confirmatory tests of floor slabs, which should show a strength higher than originally thought necessary for the service of the bridge.

With these achievements, with indefinite permanence of the bridge in sight, with a rare balance of form

and detail to the point of high esthetic success, Ralph Modjeski and his collaborators might well feel satisfaction over their work. But it remains to add the not unimportant item that they carried out their work on schedule time and within their cost limits, rapidly and efficiently, and with no breath of scandal, recrimination or dispute. In this, too, they served the public interest in high degree and invite the admiration and thanks of their professional colleagues.

A Long Quest

As more and more study is devoted to exploring the type of failure known as fatigue of metal its mystery becomes more, rather than less, obscure. New fields for investigation appear to open up with each new finding of the investigators. Thus, the several new observations on fatigue reported to the American Society for Testing Materials two weeks ago, while adding to our stock of knowledge and to some extent clarifying our outlook, bring forward new questions and puzzles. In consequence the end of the quest after the secret of fatigue seems farther off now than a new hypothesis of fatigue.

One important contribution, made by the Westinghouse research laboratory, was the demonstration that axial-stress fatigue and flexural fatigue yield identical results, in other words that a piece subjected to reciprocating tension and compression has its endurance limit at a mean stress identical with the extreme-fiber bending stress in a rotating-beam piece at its endurance limit. This result seems to agree with what mechanical instinct suggests, but it deals a hard blow to the most promising theory of fatigue action—that which attributes final failure to the slow selective growth of a minute internal weak spot under the progressive rending action of the alternating stresses. Obviously, only a small part of the material in a beam is under maximum stress, while in an axially-stressed piece all of the material is subject to the same stress; hence in the latter piece there is vastly greater opportunity for the repeated stressing to search out a little flaw and make use of it to destroy the piece. It is inconceivable, therefore, that the endurance limit of the axially-stressed piece should be as high as that of the rotating beam, if the theory indicated is right. And, as a matter of fact, it was hitherto believed that the axial-stress endurance limit was actually the lower. Now that this belief has been overthrown, the theory is no longer tenable. It becomes necessary to build up a new hypothesis of fatigue and put it to scrutiny in the testing laboratory.

Bearing in some measure on the same question, the experimental results reported from the McCook Field laboratory on the endurance-weakening effect of grooves and threads make a demand for further investigative work. It was found that such indentations have a profound influence on endurance, while they are apt to prove disappointingly neutral in static tests. Stress concentration at the root of a groove or thread is often ironed out in static tests, sometimes so much that the piece appears actually stronger (in the root area) than a plain piece; but this same stress concentration makes itself felt in fatigue tests. This is in general consonance with the theory already mentioned. But at best it cannot be held to give definite support to the theory, and its real meaning remains to be made clear in future investigations. It would be interesting, for one thing, to know how a notched piece behaves under axial-stress fatigue, since it is quite improbable that the concentration of stress in this case is of the same kind as in a similar rotating-beam specimen. Here, too, then, the new results do not explain, but require more work for their own explanation.

The work of the Navy laboratory at Annapolis also raises question, but in other directions. Instead of centering around the endurance limit—the stress which can be endured throughout an indefinitely large number of repetitions—this work dealt largely with what goes on at far higher stresses. The past year's experiments showed that fatigue stressing could be carried on at very high stresses; the number of cycles decreased correspondingly, but always followed a law consistent with that which holds for hundreds of thousands and even many millions of repetitions. It is not a new observation that repeated-stress failure can be brought about in a small number of cycles, but it is new, and decidedly remarkable, that one consistent law should hold for a few hundred cycles and for millions of cycles. This new fact reflects an unexpectedly systematic kind of behavior of the material, and strongly suggests that all progressive rupture is correlated with something inherent in the nature of the material rather than with fortuitous distribution of microflaws. Granting all that can be credited to the law of chances when there are sufficiently many dice in the box, nevertheless it does not seem capable of explaining the concordant results of fatigue tests. Suppose a piece is observed to fail at 40,000 lb. stress in two million cycles, and that a similar piece is capable of withstanding 80,000 lb. stress for two thousand cycles, is this pair of facts consistent with the view that the 40,000-lb. stress was able to overcome the resistance of the material at one small spot in its interior and start a progressive break? The new observations seem to deny this, and at the same time raise direct question as to the nature of the resistance that causes test results at 40,000 and at 80,000 to group themselves in orderly array along a single curve.

It seems plausible, moreover, that the law of action which holds for a range from a million cycles to a hundred cycles may also hold for one cycle, or even for half a cycle, that is, for singly-applied stress. Thus it may be that when we arrive at a satisfactory explanation of fatigue failure we will also hold the key to ordinary rupture. There seems to be more things in fatigue action than are dreamt of in our philosophies to date.

More confusion is brought into the subject by the Annapolis experiments on simultaneous corrosion and cyclic stressing. A water stream directed on a test specimen in the fatigue machine lowered its endurance limit by a material amount. This phenomenon also has no place in current rationalizing on fatigue, and so constitutes another theme for new investigation. Whether it will be the starting point for discoveries dealing with the cementing material of the steel composite, or whether it will merely lead back to a new, perfected version of the progressive-cracking theories, can hardly yet be a subject even of speculation. But it cannot be doubted that the observation opens a broad field for future research. It further complicates the lengthening study of fatigue and endurance.

Ottawa Terminal Freight Yard on Pere Marquette Ry.

Gravity Switching Yard Near Toledo, Ohio—Easy Grades Require No Car Riders—Track Scales Not on the Humps—Transfer Movements to and from Various City Yards

TO MEET the requirements of extensive interchange traffic with the numerous railroads centering at Toledo, Ohio, the Pere Marquette Ry. has built a large terminal yard at Erie, Mich., about 12 miles from the Toledo union station, and known as the Ottawa yard. Since Toledo is the southern terminal of the Pere Marquette system the yard is an initial and destination point for all freight trains, with no through movements of trains, as at division yards. All movements between this yard and Toledo are transfer movements of cars to or from city terminals and to or from the yards of other railroads. About 14 trunk lines enter the city and a large proportion of the interchange and transfer movements is handled by or over the line of the Toledo Terminal R.R., which is owned by a group of the trunk lines.

Traffic Conditions—The Pere Marquette Ry. main track ended formerly at Alexis, Mich., see Fig. 1, from

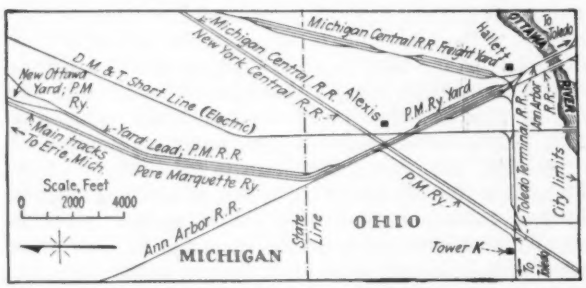


FIG. 1—RAILROAD CONNECTIONS OF NEW FREIGHT YARD

which point the track of the Ann Arbor R.R. was used to the old Ottawa yard, located south of the Ottawa River. Since it was impracticable to extend this yard to meet the needs of increasing traffic, the Pere Marquette Ry. decided to build an entirely new yard between Erie and Alexis, sufficient land being acquired to provide for future extension. New freight main tracks were also built leading from the new yard to connections with the Toledo Terminal R.R. at Hallett, and also at Tower K where the terminal road crosses the New York Central R.R.

As Toledo is either a division or a terminal point on some fourteen steam railroads, the amount of interchange traffic is very heavy. For the Pere Marquette Ry. the number of cars delivered to and received from other roads ranges from 28,000 to 36,000 per month (including both directions). In addition, it has from 700 to 1,000 cars per month, terminating at and starting from Toledo. Main line trains are made up at the Ottawa yard for several division points, besides while there are local freights. The total number of main line trains handled daily at this yard averages eleven incoming (southbound) and eleven outgoing (northbound). In addition there are about sixteen movements of transfer trains during the day, between the Ottawa yard and various railway terminals at Toledo. These movements are handled in part by the Pere Marquette Ry. and in part by the several other connecting roads. Interchange with the Toledo Terminal R.R. is handled in alternate months by the engines of this road and the Pere Marquette Ry. At Toledo, the Pere Marquette Ry. uses the city yard and freight house of the New York, Chicago & St. Louis R.R., and cars between that point and the Ottawa yard are handled by Pere Marquette transfer engines.

General Yard Layout—With the flat country, no great amount of grading was required in leveling the site for the yard. Several small streams are carried in concrete box culverts and ditches provide for surface drainage. The entire yard is drained by a system of tile drains aggregating about ten miles in length, with 32 inlets. These drains discharge into the several culverts which cross the yard.

The total length between main track connections is about 4½ miles, but the main part of the yard is concentrated near the middle of this distance. The yard lies entirely on the east side of the main tracks, as will be seen by the plan, Fig. 2. From the double-track main line, inbound trains (from the north) enter a double-track lead, parallel with and 72 ft. from the main track. This connection with the main line is equipped with an interlocking plant which is operated from a tower at the Erie passenger station. At about 4,000 ft. there is a connection with the northbound portion of the yard, beyond which the southbound lead continues for about 4,500 ft. to the ladder track of the southbound receiving yard. On the receiving track the road locomotive is cut off and goes to the engine terminal, to take coal and water as required and to be placed in the roundhouse for shelter or overhauling.

At the south end, the yard is approached by a double-track freight lead for the transfer trains. As they near the south end of the southbound departure yard these tracks diverge to permit placing between them a switching lead 1,600 ft. long. Here the transfer caboose is cut off and set on a stub gravity track having a grade of 1.5 per cent, so that the caboose is readily switched to the rear of an outgoing southbound transfer train.

Yard Design and Switching System—The yard is for a combination of gravity and flat switching, and has three groups of tracks (receiving, classification and departure) for both northbound and southbound traffic, but for convenience of operation certain of the classification tracks are assigned frequently for use as departure tracks, and certain departure tracks as classification tracks. Owing to the system of operation described below, the three groups of each set are practically side by side, instead of in a long tandem arrangement, as shown by the plan.

In the operation of this yard, the methods differ from those of an ordinary hump yard, where an entire train is pushed from the receiving tracks over the hump and the cars run by gravity into the classification tracks under the control of brakeman or car riders. Here, cars are switched in comparatively small lots or cuts, and no car riders are employed. The operations at the Ottawa yard consist in: (1) Breaking up southbound main-line trains and classifying their cars for delivery

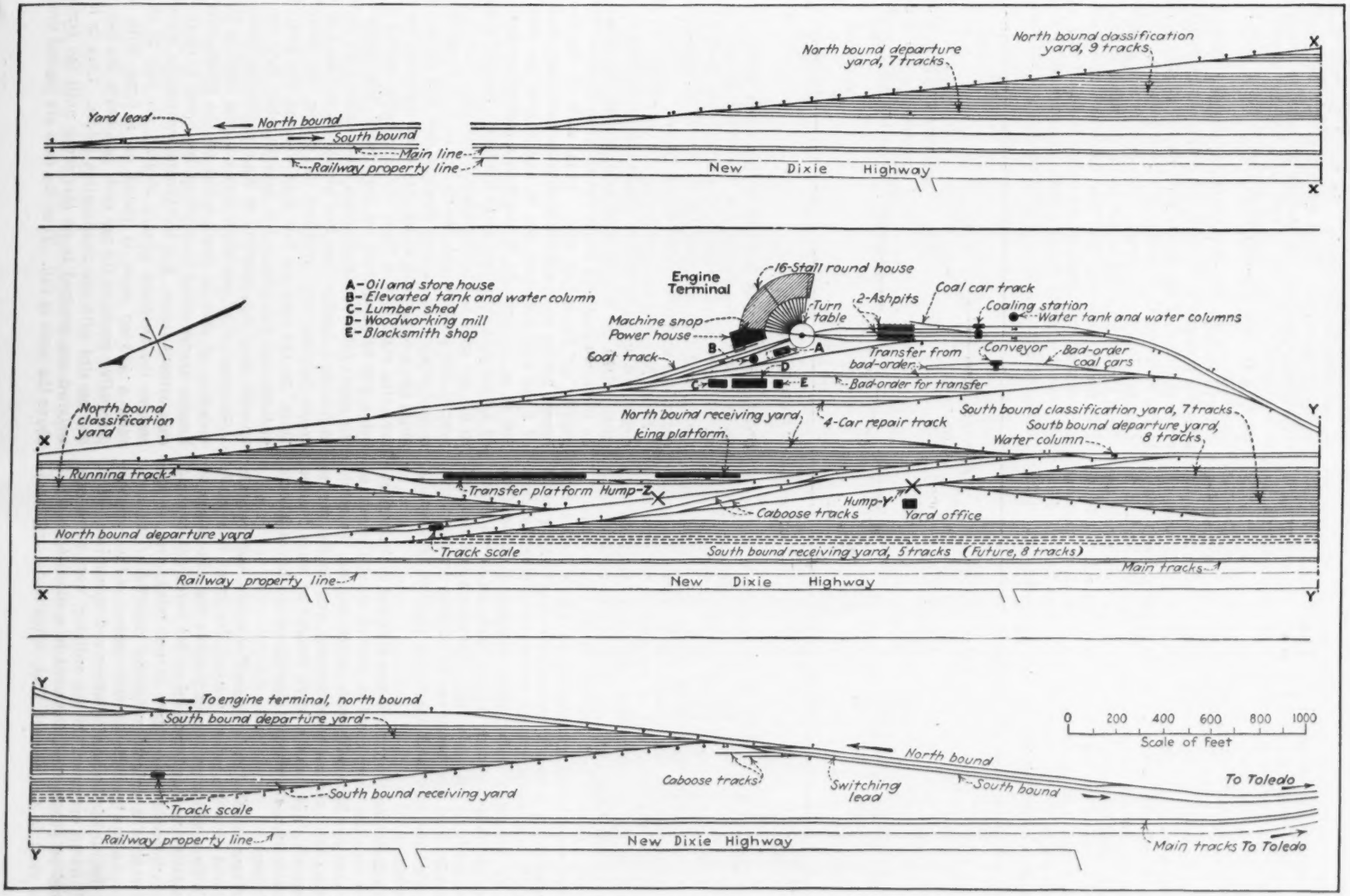


FIG. 2—OTTAWA FREIGHT YARD: PERE MARQUETTE RY.—TOTAL LENGTH BETWEEN MAIN TRADE CONNECTIONS 4¼ MILES

in puller or transfer trains moving south to the several connecting railroads at Toledo, and (2) breaking up the northbound transfer trains from these other roads and classifying their cars for making up outbound or northbound main-line trains to various points on the Pere Marquette Ry.

When a southbound train has finished its run and is left in the receiving yard by its road engine, a yard engine working on the lead track between the southbound receiving and classification yards takes off the caboose and sets it out on one of two caboose tracks, near the middle of the layout. From this track it is taken later by a second switch engine working on the lead between the northbound receiving and classification yards, and is placed at the rear of an outgoing main-line train in the northbound departure yard.

For breaking up the inbound train, the first switch engine takes a cut of 25 to 40 cars from this train, pulling it back to the lead and then pushing it over the hump at *Y*, from which the several cars run into the assigned classification tracks. These large cuts are due to the number of empty cars moving south. A switch engine at the other end of the yard takes cars from these tracks and assembles them into transfer trains on the departure tracks, ready to be taken out by the transfer engines and delivered to the other roads.

For northbound movements, in which loaded cars predominate, a switch engine pulls a cut of 20 to 25 cars from a receiving track and pushes it over the hump at *Z*. Outgoing trains, both northbound (main line) and southbound (transfer) are made up in the departure yards by level switching, either from cars switched directly from the hump or by putting together cuts which have been made up on the shorter classification tracks.

In designing the yard, it was expected that classification over the hump could be carried on at the rate of 35 cars per hour with each switch engine. In actual service this rate has been exceeded, and for full engine time, which includes a large amount of work besides classification, the engines classify an average of 30 cars per hour.

Hump and Flat Switching—Two special requirements entered into the rather unusual design of this yard: (1) To combine as far as possible the advantages of the hump yard and the level or flat yard; (2) to avoid the expense of car riders in switching, even at the expense of a reduced switching capacity. This combination has been effected with success, as the operation of the yard is both satisfactory and economical. With full hump operation, in the ordinary way, more cars could be put through the yard in a given time. But the yard is so designed that, when necessary, additional switch engines can classify cars at the outer ends of the classification yards. So far it has not been necessary to do this. These outer ends have been used occasionally, however, for making up outgoing trains; an additional engine can do this work without interfering with the classification work that is being done at the hump.

It will be noticed that this plan of working involves a reverse movement. That is, the switch engine couples on to the rear of the train, pulls its cut of cars back to the lead and then pushes it forward on the ladder track and lead to the hump. This plan is unavoidable where the entire train is not to be classified at once. It is found, however, that this additional movement (as compared with pushing an entire train directly to and over the hump) is more than compensated by the facility of distributing cars after the hump is reached.

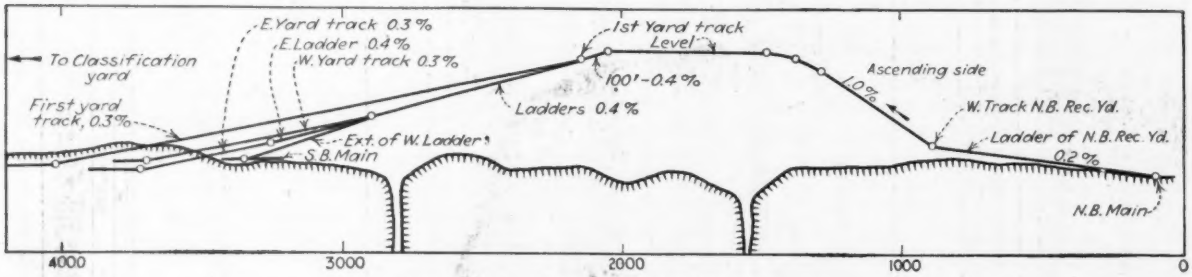


FIG. 3—PROFILE OF SWITCHING HUMP

Further advantages incident to the track layout for these reverse movements are the small amount of switching required to handle the cabooses of main-line trains, and the concentration of nearly all principal operations near the middle of the yard.

Hump Profile and Tracy Scales—In view of the above conditions the hump has relatively flat grades and has what might be termed a reverse profile, the grades on the ascending side being steeper than those on the gravity or descending side. Thus, each of the two humps has an approach track with an ascending grade of 1 per cent for about 600 ft. and is level for about 500 ft. at the summit; it has then a descending grade of 0.4 per cent extending along the ladder and reducing to 0.3 per cent on the classification tracks. The purpose of this arrangement, shown in Fig. 3, is to provide such a grade that in good weather cars will maintain about the velocity with which they leave the hump, each car being started by a "kick" by the engine instead of being left to start itself on the grade. The descending grade into the classification tracks allows the cars to run much farther than in a level yard, and the hump crews become very proficient in giving the proper "kick" to the cars, so that they will run the desired distance and yet have a low velocity when they close up with other cars standing on the classification tracks.

This method of operation does not lend itself to the weighing of cars by track scales on the hump, since heavier grades would be required, too heavy to operate cars without riders. For northbound movements, which require the weighing of only about 1 per cent of the cars, a 125-ton scale is placed on a track with a descending grade of 0.4 per cent, just below the hump and parallel with the classification ladder. Cars to be weighed are dropped in on this track until the track above the scale is full. Then the cars are pushed over

the scale, weighed, and switched to their proper tracks in the classification yard. For southbound movements, where about 4 per cent of the cars have to be weighed, the scale track is placed parallel with the shortest track of the classification yard, as shown. The cars are handled in the same way as described above.

An average movement of 1,050 cars per day requires ten 8-hour shifts of engine crews and switchmen. For night work, the yard has flood lights at advantageous points, each light consisting of 48 lamps of 1,000 watts capacity mounted on steel towers 75 ft. high and approximately 3,000 ft. apart.

Engine Terminal and Repair Yard—Six yard engines are employed and the engine terminal is designed to take care of the present maximum requirements of road, switching and transfer engines. Provision is made also for future enlargement of this terminal. Some of the road engines simply clean fires and take coal and water, and are then held on a sidetrack ready to make a return trip. For repairs or long waits the engines go to the roundhouse.

The terminal is arranged on a loop, with a double-track approach at each end, as shown in Fig. 2. Inbound engines cut off in the southbound receiving yard proceed over the ladder to the south end of the yard and then back into the terminal. Engines entering from this end pass first a water column, served by a 50,000-gal. elevated tank, and then a coaling station with a 300-ton bin serving three engine tracks. A stub track provides for coal cars supplying the coaling station. Beyond this, two of the engine tracks cross ashpits of the waterfilled type, with ashes removed by a grab bucket on an overhead traveling crane which runs on fixed runways and spans the two pits, with an ash-car track between them. The third track enables engines to bypass the ashpits and go directly to the engine-house, or by a lead to the northbound departure yard to take out a train. A view of the engine terminal is given in Fig. 4.

The three engine tracks converge at the 100-ft. electrically operated turntable, which is of the continuous-girder non-balancing type described in *Engineering News-Record*, June 5, 1924, p. 964. Beyond the turntable are two outbound tracks, with water columns served by a 50,000-gal. elevated tank. Transfer engines cut off in the northbound receiving yard pull out to the lead at the north end, and back into the terminal, going to the turntable or by a lead track to the facilities at the south end of the yard.

The enginehouse, of timber roof construction with brick walls, has sixteen tracks or stalls and the plans provide for extending it to include 26 tracks. A space of 102 ft. between the building and the turntable provides for locomotives parking or standing outside the enginehouse. At one end of the building is a machine shop and boiler room, with 100-ton coal bunker; a stub track on a timber trestle extends over this bunker for the delivery of coal. Another stub track serves the oil and supply house.

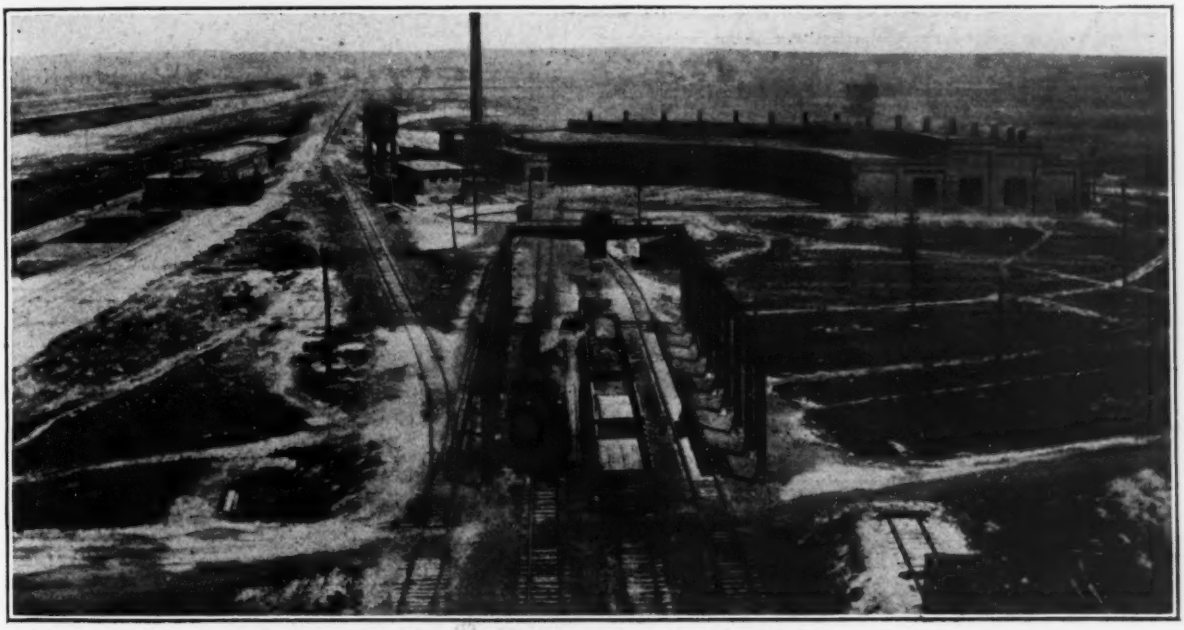


FIG. 4—ENGINE TERMINAL AT OTTAWA YARD
In the middle are the two water ashpits with ash-car track between them, served by overhead traveling crane with grab bucket. Beyond is the roundhouse. The track at the left leads to the north end of the yard.

Parallel with the engine tracks are four car-repair tracks, each 1,939 ft. long, with capacity for thirty cars. These tracks are spaced 20 ft. c. to c. and a narrow-gage material track is placed between the two middle tracks. Bad order cars are collected on a track in the classification yard and thence moved to the car-repair yard.

Special Facilities—An unusual feature is provision for the transfer of coal from bad-order cars which need more than running repairs. Such cars are switched to a track parallel with which is a track for serviceable empties, the two tracks being spaced 20 ft. c. to c. Coal is transferred by a conveyor of the endless chain and bucket type.

Two facilities provided near the middle of the yard

are a freight transfer platform and an icing platform. The former is for combining separate small L.C.L. shipments into full-car loads for the same destination or shipper, thus insuring full loads for outbound main-line trains and also releasing empty cars. A 20-ft. covered platform 600 ft. long, with wooden butterfly shelter roof 100 ft. long, is placed between two tracks spaced 35 ft. c. to c.; freight unloaded from partly filled cars on one track is reloaded into cars on the opposite side of the platform. Between the same pair of tracks is an icing station with 8-ft. double-deck platform 200 ft. long, sufficient for five cars; this platform may be extended to 400 ft. As only about two cars per day are iced at present there is no need of an icehouse. A car of ice is set on the track at one side of the platform and the blocks unloaded on the lower deck are raised by a hoist to the upper deck, and chuted to the hatches of the cars to be iced.

TRACKS OF OTTAWA YARD, PERE MARQUETTE RAILWAY

	Tracks	Northbound	Southbound
Receiving:	Number	9	5
	Length	2,638 to 4,090	4,540
	Car capacity, each	52 to 86	97
Classification:	Number	9	7
	Length	2,083 to 3,955	2,348 to 3,749
	Car capacity, each	40 to 83	45 to 78
Departure:	Number	7	8
	Length	4,285	3,480 to 4,642
	Car capacity, each	91	72 to 99

Track Work—This yard has about 45 miles of track. The sharpest curves are of 6 deg., except for the turnouts from ladders to body tracks, which have curves of 8 deg. 20 min. Ladder tracks are at an angle of 6 deg. 21 min. (or 1 in 9) with the body tracks. Yard turnouts have 15-ft. switch rails and No. 9 frogs; lead and main track connections have 22-ft. switch rails and No. 15 frogs. All turnouts have hand-operated rigid switchstands with low targets, and the switchstands are marked with painted numbers for the convenience of the yard men. No marking is provided for clearance or fouling points of yard turnouts. Rails are of 75-, 80- and 90-lb. sections, on untreated ties, with about 6 in. of gravel ballast under the ties. The track spacing is 13 ft. c. to c. for body tracks; while leads and ladders are 20 c. to c. from the nearest parallel tracks.

Engineers—This yard was designed under the direction of H. A. Cassil, chief engineer, Pere Marquette Ry., by Paul Chipman, office engineer, with the co-operation of A. L. Grandy, assistant to the president and general manager.

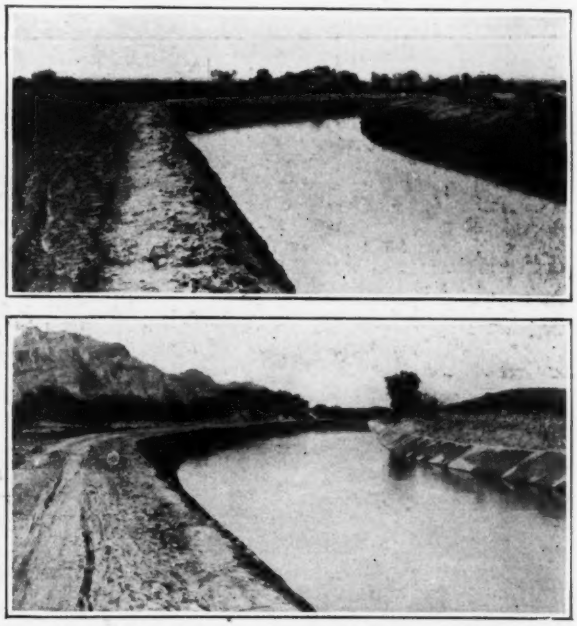
Tri-City Activated-Sludge Plant in California

Confusion due to the similarity of designation of two activated-sludge plants in California, each serving a group of three cities led to the inclusion in the article "Activated-Sludge Plant for Three California Cities," describing a plant serving Pomona, Claremont, and La Verne, in our issue of July 1, p. 10, of an airplane view of the activated-sludge plant at Alhambra, Calif., which serves Pasadena (including San Marino), South Pasadena and Alhambra—commonly known as the tri-city plant—and of a paragraph describing a study of the method of disposal of dewatered sludge at that plant. The Alhambra or tri-city plant was described in our issue of Oct. 29, 1925, p. 714, and the information regarding it should not have been included in the July 1 article.

Large Ditch-Lining Job Done at Low Cost and High Speed

Gunite Facing on 4,500,000 Sq.Ft. of Canal in Salt River Project Placed in 95 Working Days at Cost of 9.5c. per Sq.Ft.

ON THE Salt River project in Arizona a water supply has been developed with which to bring a new tract of land under irrigation by saving the leakage that previously escaped from the unlined east side main canal. In other words, the cost of lining 32 miles of main canal requiring 8,000,000 sq.ft. of lining constitutes the investment of the new district in its water supply and in return for lining the canals the Salt River Valley Water Users' Association permits the diversion from the canal system of a flow equal to the seepage previously lost in the unlined canals. This seepage loss is taken as the difference in flow in the canals, gaged under ordinary operating conditions, between the upper and the lower ends of the portions in question.

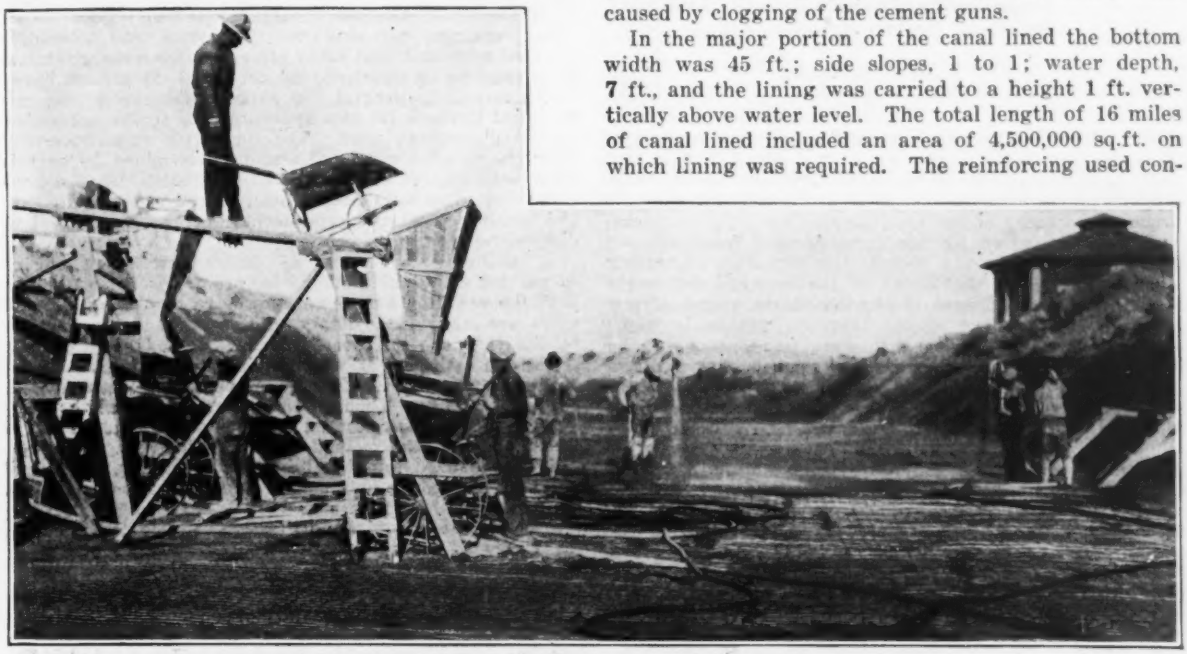


MAIN CANAL BEFORE AND AFTER PLACING OF LINING
About half the proposal total of 32 miles of canal lining of this sort was completed this season. The remainder is to be done next year.

The district that will benefit by the new supply includes about 41,000 acres east and north of the east line canal and on this area an annual delivery of 67,500 acre-ft. is expected as the result of the canal lining. This gravity flow is to be supplemented by a supply secured by pumping. The work of lining the canals was done under the direction of the engineering organization of the project with funds raised by the land to be benefited. In addition to the first cost of the lining job there will be a nominal annual charge against the new district for delivery of the specified water allotment.

The lining job just completed, which covered an area of 4,500,000 sq.ft., was done in the slack season without seriously interfering with the use of the canal. That is, for a part of its length the flow could be bypassed

and the actual shutdown of the canal was for a duration of only 3 weeks. The remaining 3,500,000 sq.ft. will be completed at the end of this present irrigation season.



GUNITE CREWS IN ACTION SHOWING METHOD OF CONCRETE DELIVERY
Material stock piles and portable concrete mixer were located on the canal bank nearby.

The work began in December and was completed in March, two 9-hr. shifts being used for the greater part of this period. The first work was the cleaning up and grading to smooth up the sides and bottom of the canal ready for the gunite. Stock piles of cement, sand and gravel were made along the bank of the canal and a portable mixer was used for each group of two guns, the product of the mixer being handled in wheelbarrows to point of delivery to the gun. Delivery was

EXCAVATING AND SCRAPING OPERATIONS TO SMOOTH UP THE CANAL
Side slopes were trimmed by hand and graders were used on the bottom.

effected by gravity discharge to the gun as shown in the accompanying illustration.

A 1:4½ mix was used, the latter figure representing material from a deposit which was found to be suitably graded. In this aggregate was included all rock that would go through a ½-in. circular screen. The material was screened twice to make sure of rejecting elongated rock and as a result there was very little outage time caused by clogging of the cement guns.

In the major portion of the canal lined the bottom width was 45 ft.; side slopes, 1 to 1; water depth, 7 ft., and the lining was carried to a height 1 ft. vertically above water level. The total length of 16 miles of canal lined included an area of 4,500,000 sq.ft. on which lining was required. The reinforcing used consisted of Clinton electrically welded 4x4-in. No. 14 galvanized wire fabric in 100-in. widths. This was held in the center of the gunite lining by hand, at each gun. The endeavor was to place a gunite lining with a minimum thickness of from 1 to 1½ in., depending on local conditions.

Two men were used on each gun, that is, a nozzle man and a helper, to keep the reinforcing in place and to relieve the nozzle man at times. Ordinarily three wheelbarrow men were required to supply each gun. Using rates of 80c. per hr. for foreman, 75c. for nozzle man, 60c. for gun man, 50c. for mixer-runner, 40c. for helper and 30c. for common labor, a crew of 22 men operating two guns cost about $9 per hour. With six guns working, a daily progress of 65,000 sq.ft. was often made in the two 9-hr. shifts. An average progress of 4,700 sq.ft. per gun per 9-hr. shift was maintained during the entire progress of the work that extended over 95 working days. Averaged over the work as a whole, the cost records showed 1.15c. per sq.ft. for labor cost in placing the gunite, including compressor operation and upkeep. The complete cost including plant was 9½c. per sq.ft. The items included in figuring up this total, in addition to the labor costs above, were grading, cement, steel reinforcing, power, equipment rental, depreciation, overhead, supervision and insurance.

The work was done by the construction department of the Salt River Valley Water Users' Association under the direction of C. C. Cragin, general manager and chief engineer. F. J. O'Hara was assistant chief engineer, P. J. Lynch in charge of the construction department, and Chris Larsen construction superintendent.

Care of Detail in Testing and Specifying Materials

From Presidential Address to the American Society for Testing Materials, June 22, 1926

By W. H. Fulweiler
Chemical Engineer, United Gas Improvement Co., Philadelphia

IN CONSIDERING the standardization of a method of testing for use in a specification we should first be sure that its results will be of use in identifying properties that will be of service in securing a desired material or product. In many of our specifications too little consideration has been given to this question, and frequently we include requirements in a specification that have no bearing whatsoever on the usefulness of the material but serve merely as a rough means of identifying the source of raw material. If we have agreed that the method is worth standardizing, we should then consider thoroughly the fundamentals of the method. Upon what physical laws does it depend? Is it a method that can be expected to reproduce results; or is it one that is purely empirical, the reproducibility of the results depending entirely upon exact duplication of apparatus and conditions?

The methods used for estimating soluble bitumen may be cited. The test consists in treating the sample with a solvent and determining either the amount of residue remaining on a filter or the amount of soluble material remaining after the evaporation of the solvent. A study of the principles underlying this type of method has indicated that the result may be influenced by the purity of the particular solvent used, the amount of solvent used, absorption of the solvent by the insoluble matter, the formation of colloidal suspensions of insoluble matter, precipitation by the solvents of colloidal material, and various combinations of these effects. The effect of time, exposure to light and the characteristics of the filtering medium are also of importance. It must be evident that only by very careful duplication of all the test conditions can such methods give satisfactory results.

It seems impossible that one can be too careful in proofreading the text of a method. In the distillation method for road materials, published as tentative in 1911, the cylinders to be used in receiving the distillate were described as graduated in 0.1 mm. As a matter of fact this was an error; the cylinders were really graduated in 0.5 mm. The method was adopted as a standard in 1916 and was universally used throughout the United States in the distillation of tar road materials, yet it was not until 1925 that some one noticed that a 25-mm. cylinder graduated in 0.1 mm. was too long to be used in the apparatus as set up. It would be difficult to estimate how many people had read this method and used it daily, and yet no one noticed the fact that the specified cylinder was obviously in error. Probably the only way to eliminate such errors in detail is to have some one who knows nothing of the method set up the apparatus and then check it over for compliance with the specifications.

Another point that is frequently lost sight of is the giving of specific directions for actually assembling the apparatus. I will cite, for example, the method for the distillation of creosote oil. This had been used in the industry for many years prior to having been proposed as tentative in 1915. A cut is given of the assembled apparatus but nothing is said regarding the angle made by the delivery tube of the retort to the horizontal; yet it is well known that the results can be varied considerably by changing this angle.

In writing new standards, considerable study should be given to the dimensions and tolerances that are specified for the different pieces of apparatus, to the end that we may be able to determine which are important and which are unimportant. I will illustrate this point by the float test, a method of testing the consistency of solid and semi-solid materials that was first presented in 1917 through Committee D-7 on Timber as a part of the methods of analysis of creosote oil. Very few dimensions were given for the apparatus, but satisfactory results were obtained because the apparatus was all manufactured by one maker. Some years later, however, other makers began to manufacture this apparatus, and it soon became evident that the dimensions originally given were not sufficient to insure satisfactory results. So the standardization of the test was taken up by Committee D-4 on Road and Paving Materials, and after consultation with the U. S. Bureau of Standards a very complete set of dimensions was adopted. It was soon found, however, that the committee had now gone to the other extreme and that the dimensions and tolerances adopted were such that many pieces of apparatus which had been retained as standards did not fulfill the present specifications and in general the average laboratory was not equipped to check its own apparatus due to the refinement in the dimensions used. The committee then undertook some co-operative work and actually determined, by experiment with apparatus of different dimensions, what dimensions and what tolerances could be used without affecting the result beyond the experimental error. These revised dimensions are now in use.

In outlining a method of determination, we cannot in general make our methods foolproof. We must assume that the operator has some knowledge of the work. Yet there are many little details of important bearing on the results that can be covered in our methods and yet are sometimes omitted. It may require several years' experience with a method before all of these important details become apparent. Thus, in the determination of the softening point or float test on residues from creosote oil, it was found that the method of cooling the sample after it had been poured into the brass collar had an important effect on the results obtained. Some materials developed a crystalline structure on slow cooling that considerably increased the time required in the test, in some cases extending it beyond the specification limits. It was found, however, that by chilling the material immediately after pouring this effect could be eliminated. May I again call your attention to the importance of little things?

In expressing results, there are three factors to be considered: The precision with which the results are expressed, the accuracy attainable by the method, and the reproducibility of results by different laboratories. These three factors in many cases, however, bear no relation to one another. When we see a result, say 20.31, expressed to two places of decimals, we would consider that it is expressed to a relatively high degree of precision; but this result may be a whole unit in error so far as accuracy is concerned, and it may well be that two different laboratories will not reproduce the same result to within two units. It would seem that the precision with which we express results should bear some relation to our ability to duplicate the figures on consecutive tests.

The whole question of precision, accuracy, exactness and correctness could well be studied. I believe that investigation of the methods of testing with reference to these points will prove very valuable. In one case, for example, where it had been the custom to take the average of the results on two samples it was shown that 27 samples should be used to secure an accuracy of 3 units. In another case, where a result was reported to one-half a unit, it appeared questionable as to whether two units was not a better precision, taking into consideration the ability of different laboratories to reproduce the results.

Illuminating Gas for Metal Cutting

Illuminating gas to replace acetylene, hydrogen and other fuel gases in combination with oxygen for metal cutting has been adopted at the Schenectady plant of the General Electric Co. A special oxy-illuminating gas torch was developed for the purpose, and is now being used for the cutting of risers in the steel foundry of the plant, varying in thickness from 1 to 20 inches. As a result of tests, it is said to have been found that illuminating gas is cheaper than either hydrogen or acetylene, while the speed of cutting after once starting is approximately equal for all gases. Advantages of the use of illuminating gas were found to be (1) availability; (2) elimination of delays and handling of tanks; (3) low cost; (4) safety, and (5) chemical and physical properties permitting its use in a torch equipped with a superheater, thus effecting marked economies in the oxygen at the cutting jet.

Tests in Growing Vegetation on Gravel Dams

Experimental Plantings on Hydraulic Fill Dams of Miami Conservancy District Determine Grasses Growing Best on Coarse Gravel Without Topsoil

By C. H. Eiffert
Chief Engineer, Miami Conservancy District, Dayton, Ohio

AFTER the completion of the dams and levees built by the Miami Conservancy District in southwestern Ohio it was necessary to devise some means of securing a protective covering for the parts of the slopes not protected by riprap or revetment. The lower portions of the upstream slopes of the dams are paved with stone riprap to a height which will be reached infrequently by backwater; above this elevation the slopes are of gravel. The levee slopes along the channel improvements are protected by concrete revetment only on curves and at certain other particularly exposed places. Considerable experimenting has been done to develop a cover of grass or other vegetation on these slopes.

The dams are of the hydraulic fill type, the coarsest material being in the slopes. The nature of this material, consisting of sand and gravel, is shown in Fig. 1. It is far from ideal for the growth of vegetation. The original plan was to cover the slopes with a layer of topsoil and grass them. The scheme was abandoned because, first, the placing of topsoil was very expensive; second, a great deal of wash occurred during heavy rains, before the grass obtained a sufficient start to prevent it, due partly to the impervious nature of the topsoil.

On the slopes of the Germantown dam a number of plots were staked off and these were seeded or planted with different kinds of grasses, clovers, shrubs, etc. The layout of these plots is shown in Table I. The planting was done in March, April and May, 1921. After sowing, the seed was thoroughly raked in with steel toothed garden rakes.

The seedings were inspected periodically. In January, 1922, the results were as follows:

Of the honeysuckle on plots A and I about 75 per cent survived and had made some growth. Those to which woods dirt had been added made a considerably better showing than the others. Plots B, C, F, G and H had burned out during the summer. On plot D the sweet clover had made a good growth, the best in fact of any of the plots. Plot E had burned out except the sweet clover. On plots J and K the bunch grass and horsetail ferns made a good growth.

The plants on plots L to P had survived but showed no signs of spreading.

The condition of the grass on the topsoil area, Q, was very poor, mostly burned out.

On the small test plots 1 to 21 the conditions were as follows:

9, 12, 13 and 16, poor: 1, 3 to 8, 11, 15, 17, 18, 19 and 21, fair, and 2, 10, 14, 16, 20, good.

On account of the unfavorable results obtained from many of the plots started in the spring of 1921, additional seedings were made in the fall covering plots A, B, C, F, G, H and I, as shown by Table II.

The fall weather was very favorable for the germination of these seeds and the nurse crop was soon far enough advanced to prevent erosion from the fall and winter rains. The topsoiled slope was also reseeded with

TABLE I—SCHEDULE OF TEST PLANTINGS ON GRAVEL DAM SLOPE

Plot A — 40,000 sq.ft. with 3,900 honeysuckle vines spaced 3x3, 4x4, and 6x6 ft. Planted directly in the sand and gravel except 60 vines under guard rail given one shovelful of woods dirt to each plant.

Plot B—56,000 sq.ft. Nurse crop of rye 30 lb. Grass mixture: brome grass 10 lb., timothy 6 lb., red top 2 lb., Canada blue grass 4 lb., Kentucky blue grass 4 lb.

Plot C—15,000 sq.ft. Nurse crop of rye 20 lb., brome grass 10 lb.

Plot D—17,000 sq.ft. Sweet clover (alba) 8 lb.

Plot E—20,000 sq.ft. Nurse crop rye 20 lb., brome grass 4 lb., sweet clover 4 lb., timothy 3 lb.

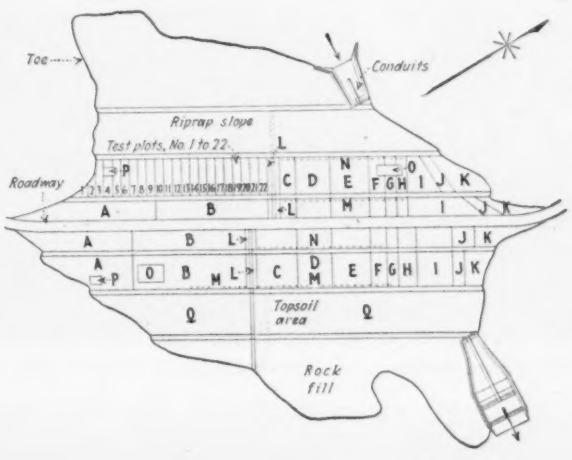
Plot F—8,000 sq.ft. Nurse crop rye 8 lb., red top 2 lb.

Plot G—6,500 sq.ft. Japan clover 10 lb.

Plot H—7,400 sq.ft. Sweet clover (yellow) 10 lb.

Plot I—20,000 sq.ft. Honeysuckle 500 Hall's, 500 Aurea, planted 3 ft. apart each way.

Plot J—7,500 sq.ft. Tufts of wild bunch grass (andropagan) from the hills near dam; in the gravel 2 ft. apart.



Plot K—14,000 sq.ft. 2,000 horsetail ferns (equisetum) from nearby swamp; 2 ft. apart.

Plot L—4,800 sq.ft. 300 blanda roses 3 ft. apart.

Plot M—Row 720 ft. long planted with 80 red Dorothy Perkins roses, 80 Lady Gay roses, 80 Michuriana roses—3 ft. apart, one pint of topsoil each plant.

Plot N—Row 540 ft. long planted with 180 Boston ivy 3 ft. apart, a pint of topsoil with each plant.

Plot O—3,600 sq.ft. 300 sweet sumach 3 ft. apart.

Plot P—1,000 sq.ft. 160 St. John's wort 2½ ft. apart each way, one shovelful topsoil with each plant. Planted October, 1920.

Plot Q—100,000 sq.ft. topsoiled area on downstream 3 to 1 and 4 to 1 slopes. Nurse crop rye 100 lb. Grass mixture: Kentucky blue grass 10 lb., Canada blue grass 10 lb., Alsike clover 5 lb., timothy, 8 lb., red top 8 lb. Sowed Nov., 1921.

Plots 1 to 21 sown October, 1921. Each contains approximately 1,200 sq.ft. except 1 and 2. A nurse crop of 64 lb. oats and 20 lb. Sudan grass was sown over the 21 plots. This was followed by seed for the individual plots:

Plot	Amount Lb.	Seed
1	2	Henderson's special mix
2	1	Orchard grass
3	1	Crested dog's tail grass
4	2	Sheep's fescue
5	2	Hard fescue
6	2	Red or creeping fescue
7	2	Henderson's special mix
8	1½	Canada blue grass
9	1½	Kentucky blue grass
10	2	Timothy
11	2½	Perennial rye grass
12	2	White bloom sweet clover
13	2	Yellow bloom sweet clover
14	1½	Brome grass
15	2	Red top, Alsike and sweet clover
16	2	Alfalfa
17	2	Red top, Canada blue and Kentucky blue grass
18	2	Sheep's and red fescue, equal parts
19	2	Henderson's special mix
20	2	Mixture of red top, Alsike, sweet clover, Canada blue and Kentucky blue grass
21	2	Sheep's fescue and Henderson's special mix

FIG. 1—HORSETAIL FERNS AND BUNCH GRASS SOON AFTER PLANTING

FIG. 2—HORSETAIL FERNS AND BUNCH GRASS 4½ YEARS AFTER PLANTING

FIG. 3—FESCUE GRASS SHORT AND THICK WITHIN DEAD SWEET CLOVER

FIG. 4—MIXED GRASSES ON AREA COVERED WITH TOPSOIL

FIG. 5—HONEYSUCKLE SOON AFTER PLANTING IN 1921

FIG. 6—HONEYSUCKLE IN FALL OF 1925

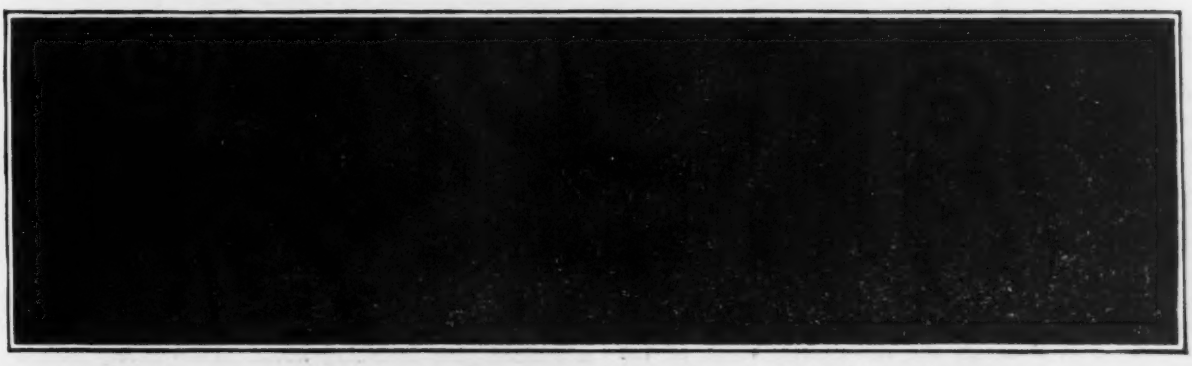


FIG. 7—FIRST YEAR GROWTH OF SWEET CLOVER, ENGLEWOOD DAM

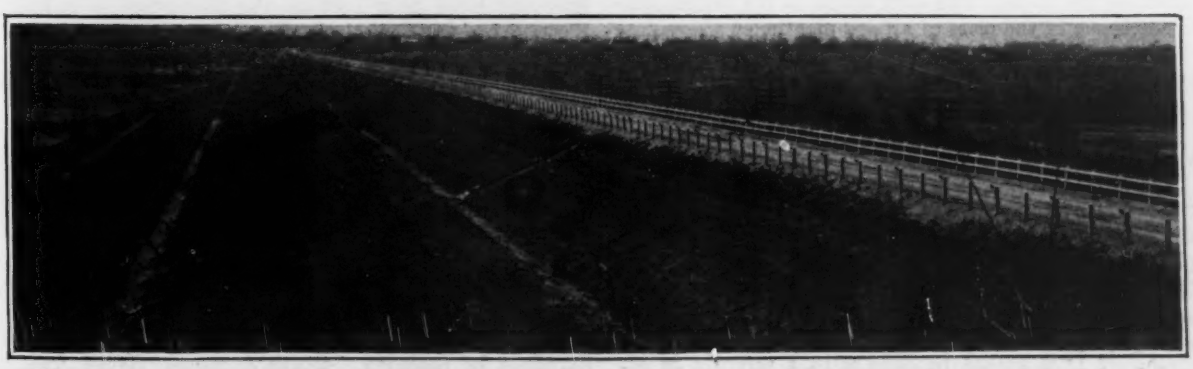


FIG. 8—DEAD SWEET CLOVER ON DOWNSTREAM SLOPE, ENGLEWOOD DAM

a mixture somewhat similar to the above. Additional seedings have been made at various times since the fall of 1921 until now the entire dam is covered with a fairly good growth of sweet clover, alfalfa and a variety of grasses.

A careful inspection of the dam was made in October, 1925. This showed that a number of the original seed plots had persisted and made an excellent growth. Some of them were surprisingly good.

The results can perhaps be best illustrated by the views. Fig. 1 shows the horsetail ferns and the bunch grass soon after planting in 1921, and Fig. 2 these same plantings in October, 1925. The horestail ferns are now from 2 to 4 in. apart where the original plants were 2 ft. apart both ways. The bunches of grass originally planted 2 ft. apart have greatly enlarged and new grass has started between them. While the ground has not yet been completely covered it probably will be in the course of another year or two. A very good stand of brome grass was found on plot *E*. Plots 4 and 5 show an excellent sod of fescue grasses. This is illustrated in Fig. 3. The large dead stalks are those of sweet clover. Fig. 4 shows the excellent growth of mixed grasses on the topsoiled area. The growth of honeysuckle on plot *A* is shown in Figs. 5 and 6.

TABLE II—SCHEDULE OF 1921 FALL PLANTINGS, GERMANTOWN DAM

Upstream (northwest) Slopes		Downstream (southeast) Slope	
Nurse crop	Lb.	Nurse crop	Lb.
Oats	60	Oats	60
Sudan	20	Sudan	20
Grass mixture		Grass mixture	
Brome grass	20	Brome grass	20
Kentucky blue grass	6	Canada blue grass	5
Canada blue grass	6	Kentucky blue grass	2
Perennial rye	4	Perennial rye grass	5
Timothy	8	Sweet clover (alba)	4
Sweet clover (alba)	4	Alsike clover	3

The treatment at the Lockington and Taylorsville dams was somewhat similar to that at Germantown and similar results were obtained. At Englewood and Huffman the entire dams were seeded with sweet clover in the spring of 1922. An excellent stand was obtained. In addition to the sweet clover a few good-sized plots were seeded and these also showed very good results. The sweet clover was reseeded every second year and a good stand was secured in every case. The plots of alfalfa have not been reseeded and the stand is still very good. Fig. 7 shows a close-up of a stand of sweet clover. Fig. 8 shows the downstream slope of the Englewood dam at the end of the second year of a crop of sweet clover. The plants are all dead and matted down on the slope. The dark space in the middle distance is one of the plots of alfalfa mentioned above.

The soil conditions on these slopes have been greatly improved by the decay of the sweet clover as well as by the fixation of nitrogen from the air. All sweet clover and alfalfa seed was inoculated and this is no doubt one reason for the excellent stands obtained.

When the work was first begun it was thought that raking in of the seed would not be necessary because of the loose nature of the slopes. Some of the early test plots showed this to be a mistake. It was found that a thorough job of raking with heavy steel rakes was essential.

It was decided that any reseeding necessary in the spring of 1926 should be done with a mixture of alfalfa, brome grass, fescue grass and possibly some blue grass. It is believed that the repeated crops of sweet clover, none of which were removed, have made a sufficient improvement in the soil to enable these grasses to take hold.

As topsoil was more easily obtainable and more easily placed along the levees than at the dams, most of the levees were covered with 6 in. of topsoil. Practically all of the levees were at first seeded with a mixture consisting of 30 lb. Kentucky blue grass per acre, 30 lb. red top grass per acre, 5 to 10 lb. timothy per acre and 4 lb. white clover per acre. With this was sowed a nurse crop of oats if the seeding was done in spring, or rye if done in the fall.

The results were very satisfactory on the topsoiled levees although it was necessary to do considerable reseeding in spots. On some gravelly slopes where topsoil had not been placed, it was found necessary to make a start with sweet clover and alfalfa. At the present time most of the levee slopes are covered with a good sod of blue grass and the remainder have a good stand of clover or alfalfa and other grasses. Brome grass was also used with good results in one locality.

There was a very marked difference in the development of the growth between the north and south slopes. The seed seemed to germinate equally well on both sides but the growth on the south side was often unable to survive a prolonged dry period. One levee has an excellent blue grass sod on the north side while on the south slope it has been impossible to get blue grass started at all. This slope was finally seeded with alfalfa last spring and a good stand obtained.

Flood Protection for Dallas, Tex.

A revised project for flood protection and land reclamation along the Trinity River at Dallas, Tex., is now in its preliminary and legal stages. Under the original plan, outlined in *Engineering News-Record* of Aug. 25, 1921, p. 327, an area of 5,500 acres was included, of which approximately 4,000 acres were to be reclaimed. This plan was based upon the levying of assessments on a portion of the business section of Dallas, on the basis of reflected benefits. But the scheme of assessment was very unpopular and the cost per acre for the reclamation was so high that the plan was abandoned temporarily after the surveys had been completed and estimates of the cost prepared.

About a year ago the engineers commenced work on a revised plan including about 14,000 acres, with a total cost considerably below the $4,800,000 of the original plan. The old district has been abandoned and hearings have been held on the formation of a new district, but the Commissioner's Court of Dallas County has been enjoined from taking any action on the proposed district. However, it is expected that the injunction will be dissolved, so that the District Court can proceed. This reclamation project includes about 25 miles of levee and a total earthwork of approximately 10,000,000 cu.yd., with an additional 6,000,000 cu.yd. of hydraulic fill in a 600-acre area closely adjacent to the business section of the city. Progress may be rather slow. There are approximately 3,000 tracts of land within the district, owned by 1,300 different interests, and since the cost is to be handled on the assessment of benefits basis, hearings must be held on each individual piece of property. Myers & Noyes, Dallas, Tex., are the engineers for this Trinity River project.

Light-Weight Coal Barge Uses a Structural Steel Framework

Fox River Navigation Co. Develops Own Design That Weighs 20 Tons Less Than Wooden Barge of Same Capacity

DESIGN characteristics that are rather unusual in coal barge construction have been incorporated in a barge built by the Fox River Navigation Co., Kaukauna, Wis. The special features of design consist of longitudinal steel trusses and a skeleton steel frame. Planking 4 in. thick bolted over the frame forms the shell of the vessel which is of comparatively light weight. Barges of all-wood construction of the same size owned by the company have a displacement of 100 tons, while the steel-frame barge displaces only 80 tons. During the 1925 season the steel-frame barge averaged 21 tons per load more than any of the other barges on the same loaded displacement.

The barge was designed and built under the supervision of Ben Prugh, manager of the company. Its construction cost was $12,426 and it was built in the winter of 1924-25. The wooden barges cost between $11,000 and $12,000 each.

Although most of the details of the barge are shown in the accompanying drawing, a few descriptive notes are necessary. The barge is of the flat iron type—pointed bow with curved rake at the stern. It is 142 ft. long and 24 ft. wide, with 8-ft. perpendicular sides. All the timber in the barge is No. 1 common and the planking is Washington fir.

In addition to the parts of the barge shown in Fig. 1, there is a forward deck 12 ft. long to provide room for two hatches, capstan and anchor. A rear deck 10 ft. long provides space for a wheel house. Fig. 2 shows these decks and a general view of the barge. There are three sets of 2½x5-in oak fenders on each side. The lower set is spiked to the grubstakes, the middle set placed opposite the decking, and the third set is bolted through the stanchions just below the top of the barge. The top angle of the side frames protects the top plank of the shell and keeps the planks from spreading when the seams are calked. The decking is 3 in. thick with 6-in. beveled piece on the edge as shown in Fig. 1, Sec. *A-A*. This beveled piece keeps the water from standing around the stanchions. A 1-in. maple dunnage deck bedded in asphalt protects the fir deck from injury and is secured to it by 8d nails.

The object of depressing the deck was to make the barges more stable when loaded, similar barges loading on a high deck having been known to roll over. The deck is also raised high enough above the bottom to allow men to crawl through and repair broken bottom plank which are frequent in the conditions under which these barges operate. The pointed bow is necessary owing to the blunted approach to the locks which the barges must pass through in their trip up the river. With this shape of barge it is only necessary to enter the bow, and the tug which is lashed to the port side can work the barge into the lock while a blunt bow would materially increase the time of lockages.

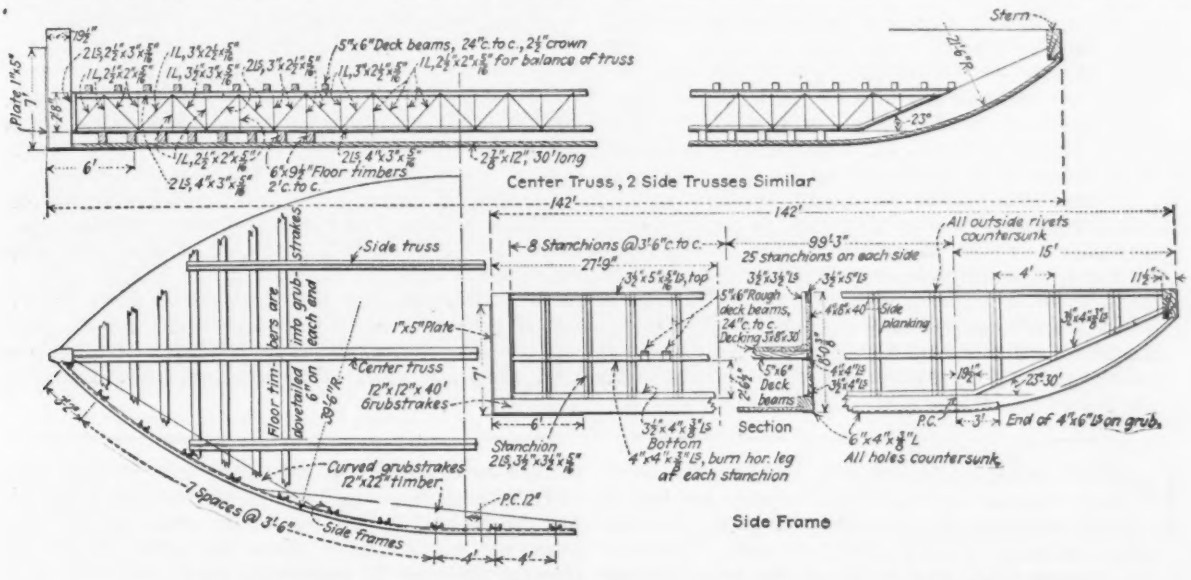


FIG. 1—DETAILS OF STEEL TRUSSES AND FRAMEWORK IN 80-TON COAL BARGE

FIG. 2—FINISHED BARGE SHOWING DEPRESSED DECK DESIGN

New York's Third Subway Under Construction

Flushing Extension and Fourteenth St. Line on Long Island Forecast Machine Methods Developed on Third Subway—Street Decked and Trench Braced to Give Working Space for Power Shovels in Cut

By T. L. MacBean
Chief Engineer, Oakdale Contracting Co., New York

Continuing a series of articles on rapid-transit subway construction now in progress in New York, where a complete new network of lines is being added to those built in 1900-1904 and 1913-1918. The first article, June 17, 1926, p. 970, outlined the planning of the new third system and the history of the three successive systems with development of design and special features.

The operations described below are no part of the third system of subways outlined in "Engineering News-Record" June 17, 1926, p. 970, but their description is pertinent to the new work because on them was developed the use of power excavation under decked streets which is the characteristic construction feature of the new subway.

Subway construction on Long Island is represented by the Flushing extension in Queens and the 14th Street line in Brooklyn. The Flushing extension is so called because it is the continuation of the Corona line now used jointly by the Interboro Rapid Transit and the Brooklyn-Manhattan Transit Companies. There have been three contracts on the extension, the first, the line west of Flushing Creek, the second the bridge over Flushing Creek and the third contract that part of the line in Flushing, L. I. The third contract is described here and consists of 550 ft. of fill and open cut to the portal of the dead-end subway which is 1,650 ft. long with a 600 ft. end station. Only the subway construction is considered here. Construction on the 14th St. line, so-called because it is an extension of the 14th St. line on Manhattan Island, consists of 7,600 ft. of subway undertaken in two contracts. The Flushing line costs $1,600,000 and is virtually finished. The 14th St. line is under construction and the contract price is $6,800,000; it is perhaps 60 per cent completed. Both lines are of the conventional two- and three-track design with concrete floor and steel bents with concrete jack-arch walls and roof. They are both cut-and-cover operations.—EDITOR.

POWER shovel excavation as a recognized subway construction process was inaugurated on the Flushing Extension in Queens and on the 14th St. line in Brooklyn of the New York subway system. As a part of the process there was developed the arch bracing system which gave a clear space for shovel operation and motor truck or train haulage while strongly supporting the roof and sides of the cut. This is the signal feature of the work done in recent years, across the East River from Manhattan, in subway construction. Its merit has carried it to the Philadelphia subway work as described in *Engineering News-Record*, May 21, 1925, p. 840, and across the river to several Manhattan operations as will be described in succeeding articles. There were on this work in Brooklyn and Queens, noteworthy underpinning and concrete practices.

The two operations were conducted by the same organization, the Oakdale Contracting Co., with E. A. Herrick, general manager, the writer as chief engineer, and John H. C. Gregg, construction engineer. They represent, therefore, variations of the same planning thought as determined by different conditions and increased experience—the Flushing extension being built first and then the 14th St. line. Enumerating briefly the broad differences, they are: (1) A large part of the excavated material on the Flushing extension was hauled by industrial railway underground to the portal and then to a fill, while shafts about five blocks apart on the 14th St. line were used to hoist the material to over-street hoppers discharging into motor trucks. (2) Street widening was necessary on the Flushing extension but there were no major street structures, while on 14th St. there were a street railway and an elevated structure, also gas and water mains to be shifted outside the cut, but there was no widening. (3) Underpinning was light on the Flushing subway but complicated by ground water, while on 14th St. there was water only in places but some rather complicated problems of supporting structures were presented. Understanding of construction methods is helped by considering classes of work rather than individual contracts.

Timbering—Timbering and excavation are coincident processes but it is more simple to consider them somewhat separately. The Flushing extension was the first under contract and the timbering plan was worked out there. As the street was narrow it had first to be widened as shown by Fig. 1. The basic idea of the contractor was to eliminate hand excavation—to use power shovels—and his timbering and excavating plan was conditioned on this object. As developed it was to open half the street with a shovel cut some 12 ft. deep, then to timber and deck this cut, then repeat the operation for the other half of the street, finally to deepen the cuts by shovels working under the timbering. The timbering design as a first requisite had to provide clear shovel room for deepening the cuts.

As developed the design is shown by Fig. 2. This happens to be a plan for the 14th St. line where a car track had to be carried but the system on the Flushing line, as shown by Fig. 3, was substantially similar. In effect the square framing familiar in past subway practice is, below the first shovel cut, replaced by an "arch bracing" depicted by the illustrations Figs. 2 and 3. Originally instead of using skew-back castings the ends of the raker braces were beveled. The castings (patented) were a later development for improvement. They simplify the timbering (1) by eliminating bevel-

ing and virtually all cutting of timbers in the trench and (2) by providing for double rakers from the same point as *A* or *B*, Fig. 2. In practice this timbering system has demonstrated its capacity to hold the sides and the street traffic and its suitability for power-shovel work below it is manifest from the illustrations.

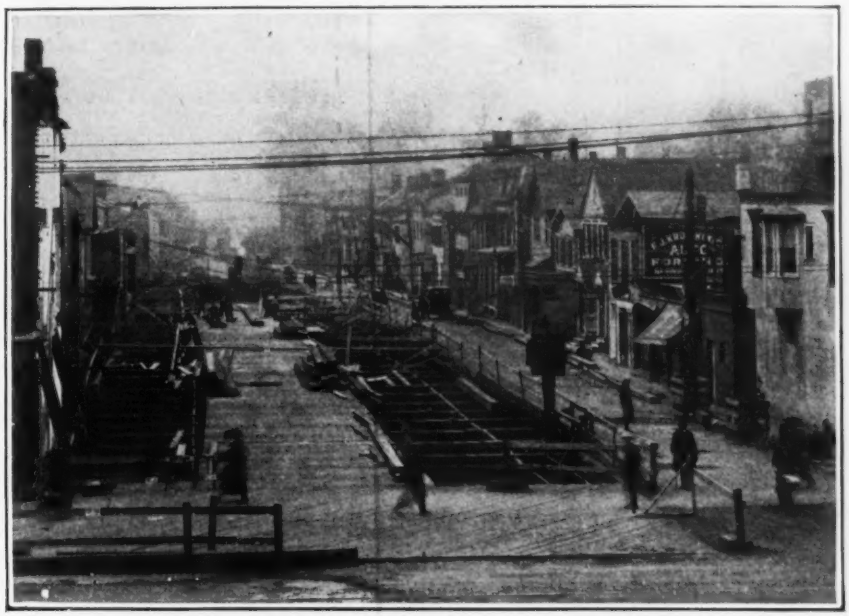


FIG. 1—STREET WIDENING OPERATIONS ON FLUSHING EXTENSION

Excavation—On the Flushing extension the cut was 53 ft. wide at the portal and 70 ft. wide at the dead-end island station. In making the first cut about 12 ft. deep to half street width, the shovels loaded into motor trucks on street grade alongside. With this cut excavated and timbered, the second cut was made alongside and the trucks stood on the decking. A view of this stage of the operation on the 14th St. line is shown by Fig. 4. In this first cut, shovels with standard booms were used but for the second cut under timbering, a specially-designed short-boom was substituted. Two of these shovels are shown by Figs. 5 and 6; one is a gas-electric shovel and the other a straight electric shovel getting outside current. Both shovels are shown in working position under the timbering.

On the Flushing line the shovel shown by Fig. 5 operated on 220 volts stepped down from the outside power line. It loaded into trains of 2-cu.yd. side-dump cars hauled by gasoline locomotives to the portal and out onto the dump. Two tracks ran into the subway and a train was operated on each track. The material was mostly a clay-gravel mixture, very hard, with sand layers. Ground water was 15 ft. above subgrade through most of the cut. It came in from a silty sand seam and had to be handled very carefully not to cause settlement. About 750 g.p.m. had to be pumped continuously. On the Flushing line the average excavation output on the opening cut was 300 cu.yd. per shovel per 8 hours, with a peak of 700 cu.yd.; under the decking an average of 200 cu.yd. per 8 hours was maintained with a peak output of 400 cu.yd.

The shovels used on the 14th St. line were gasoline-electric machines, with long booms for the first cut and short gooseneck booms as shown by Fig. 6 for the work under the timbering. When changed to work underground, however, the gasoline prime mover was cut out and current was taken from a cable installed for other purposes. With the gooseneck boom the shovel worked with a headroom of only 10 ft. The excavated material was taken out through shafts. The shaft structure above the street level is shown by Fig. 7.

On the two-track line the cut was 35 ft. wide and on the three-track line it was 50 ft. wide. The mate-

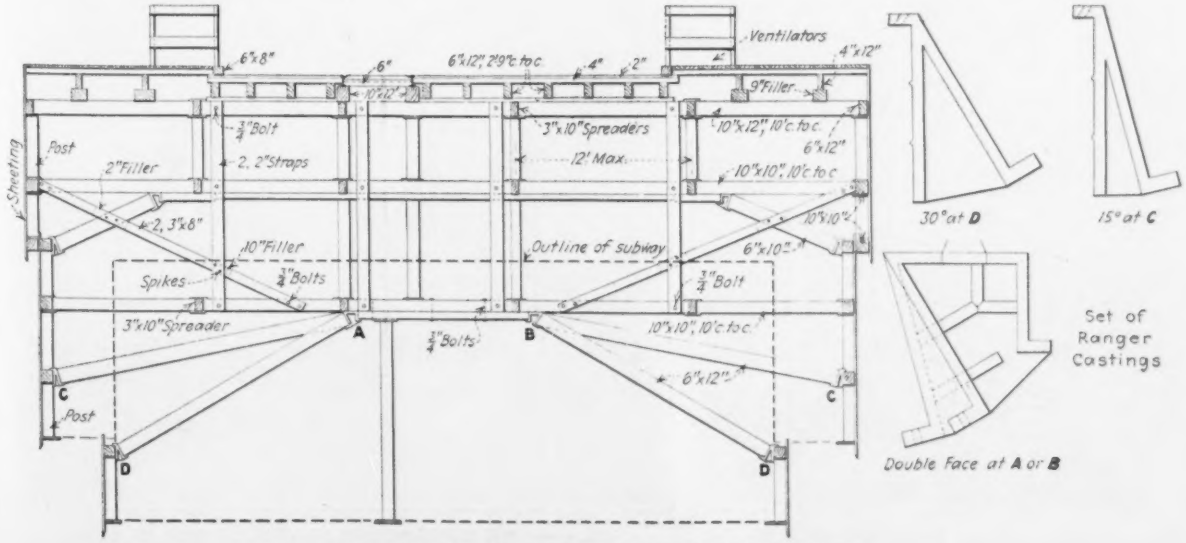


FIG. 2—ARCH BRACING SYSTEM ON 14TH STREET LINE

rial was loam and sand with some gravel and boulders interspersed. The first cut was loaded directly into trucks as already described (Fig. 4). Under the decking the shovels loaded into four-car trains hauled by

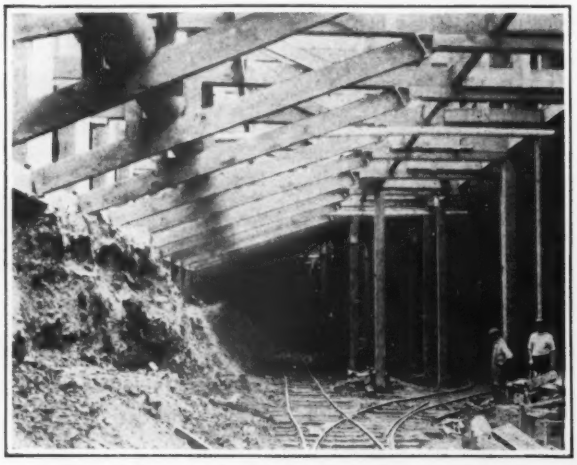


FIG. 3—ARCH BRACING AND SPOIL TRACK ON FLUSHING EXTENSION

gasoline locomotives. The cars held 2 cu.yd., dumped over the side, and at the shafts were unloaded into pits. At the shaft top an electric derrick operating a 1¼-yd. clamshell lifted the material out of the bottom pit and put it into the truck-loading hopper (Fig. 7). The shafts were about 1,500 ft. apart. Excavation has averaged about 300 cu.yd. per shovel per 8-hour day, with peaks of 600 cu.yd. in the opening cut and of 500 cu.yd. under the decking. For some 2,000 ft. ground water was 5 ft. above subgrade but it did not count heavily among the excavation obstacles.

Underpinning Methods—About 20 buildings on the Flushing extension and some 300 on the 14th St. line had to be underpinned. Familiar methods were followed, generally. Pits were sunk to below subgrade or to a point below a 1:1 slope projected from subgrade at the side of the structure; and concrete piers were built up to the old foundations. Where there was water the pits stopped at water level and from there pipe piles were forced to below subgrade, excavated and filled with concrete. These were the usual underpinning operations. For one building on the 14th St. line, there were special conditions and a different underpinning plan. The subway passes directly under a reinforced-concrete factory building with an ordinary "cement" floor on the ground and having interior columns.

Not to stop factory operations, the old cement floor

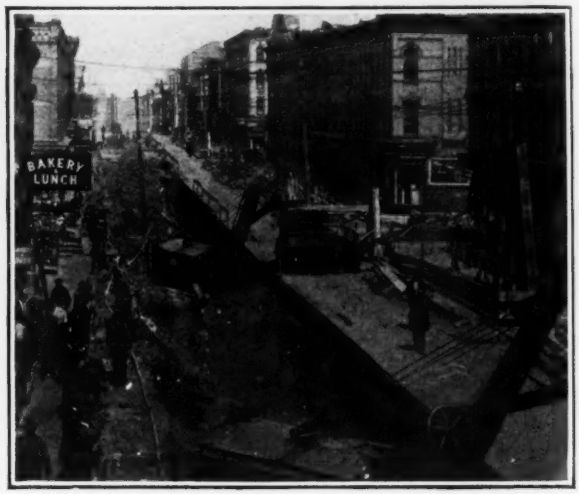


FIG. 4—OPENING AND TIMBERING STREET HALF AT A TIME, 14TH STREET LINE

will be taken up in sections and replaced with a reinforced-concrete slab. Excavation beneath will then be by hand, posts being placed under the concrete slab as the cut is opened up. Where there are building columns, underpinning pits will be sunk and timber bents placed to carry the columns until the subway is finished and they can be footed on the roof. About the same method was employed where several elevated railway columns came over the subway. A pit to below

FIG. 5—SHORT BOOM ELECTRIC SHOVEL ON FLUSHING EXTENSION

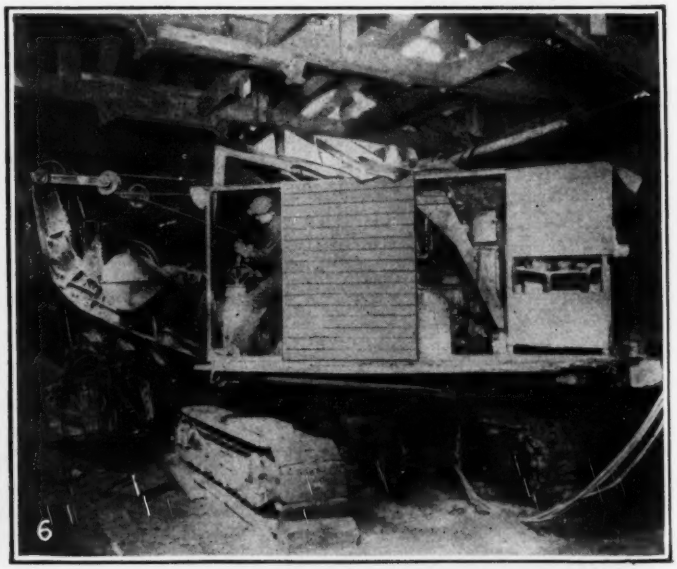


FIG. 6—GASOLINE-ELECTRIC SHOVEL ON 14TH ST. LINE WITH GOOSENECK BOOM

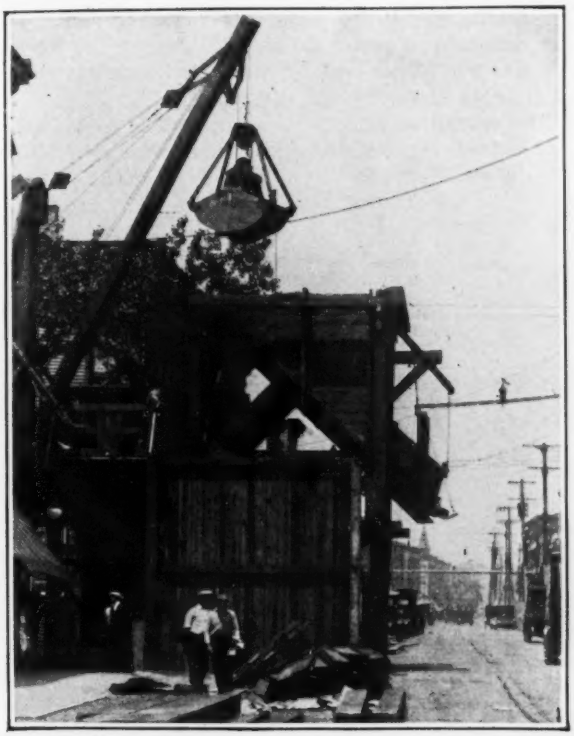


FIG. 7—SHAFT HEAD STRUCTURE ON 14TH ST. LINE

subgrade was sunk each side of the column footing in the line of the subway and a timber bent was set up in each pit. Spanning between these there was built the three-part (*A*, *B* and *C*) steel footing or grillage shown by Fig. 8. Columns outside the subway were underpinned as were buildings. At one place the subway will go under the Long Island R.R. yards. Here also it is planned to sink pits, erect bents and carry the track on steel beams spanning between bents. After the tracks are underpinned it is proposed to excavate with a locomotive crane and clamshell.

Concreting Methods—For the Flushing extension an adequate mixing plant was set up on the nearby Flushing Creek so as to receive materials by barge. The cars and tracks used for excavation carried the concrete for the subway floors and lower 2 ft. of the walls. Thereafter delivery was by motor truck over the decking from where the concrete is chuted to sides and roof.

On the 14th St. line a rather special outfit was erected. The concrete is mixed at a central plant and transported to the concreting point in 5-ton motor trucks. The cement shed is served by a railroad siding while the aggregate comes in scows and is transported to the storage piles at the plant by motor truck. A steel derrick with a 75-ft. boom, operating a clamshell bucket, places the aggregate in the feeding hoppers.

The concreting plant consists of both sand and gravel hoppers feeding through smaller measuring hoppers into the mixers, the inundation system being used to measure the sand. The mixers are of 1-yd. capacity, operated by electric motors, and are set back to back. A baffle plate above deflects the material into either one of the mixers, which can be operated together or separately. Two 18-in. belt conveyors 51 ft. long rising on a 25-deg. angle from both ends of the cement shed, carry the cement to the top of the building, discharging into a 12-in. spiral flight conveyor, which in turn discharges into the hopper directly above the mixers. The belt conveyor runs at a speed of 150 ft. per minute while the flight conveyor makes 70 r.p.m. The bags are opened on the cement shed floor and the cement placed on the belt conveyor in batches. The capacity of the cement shed is about 3,000 bbl. Provision is made for heating the aggregate by steam both in the storage piles and in the feeding hopper. During very cold weather the water is also heated. Concrete is discharged from the mixer at a temperature of about 70 deg. The mixers discharge by gravity into 5-ton motor trucks. The longest concrete haul is 1¼ miles. The entire plant is operated by electric motors.

For all standard work, steel forms have been used for placing the plain concrete arches between the side wall columns and between the roof beams. The sidewall forms are poured in units and the whole unit form is moved by chain blocks and a carrier traveling on an I-beam fastened to the kneebraces on the sidewall columns. This I-beam is moved ahead as work progresses. The roof forms are on steel travelers operating on temporary track placed on the subway floor. The traveler is in effect a movable platform with a small up-and-down adjustment by means of screw jacks. The forms themselves are on top of this platform and collapse onto it when moving them ahead.

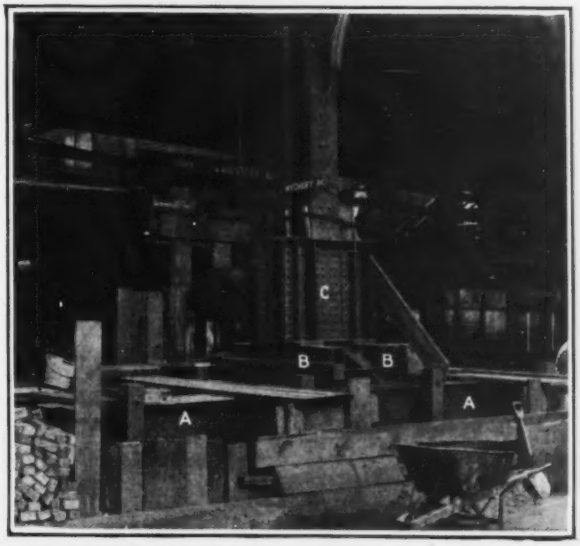


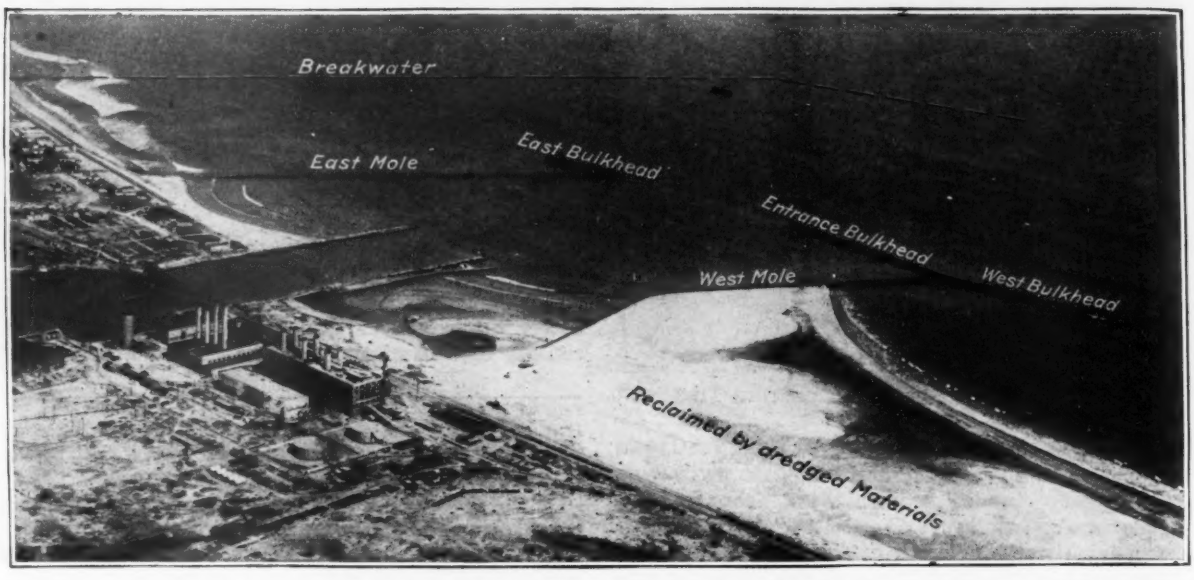
FIG. 8—UNDERPINNING ELEVATED RAILWAY COLUMN ON 14TH STREET LINE

Organization—All construction is under the supervision of the Board of Transportation of the City of New York, Robert Ridgway, chief engineer. The technical personnel of the Oakdale Contracting Co. has already been stated. In the case of the 14th St. line there were two contract sections. This made it necessary to keep construction at a specified percentage stage of progress on each section independently of progress on the other section or on the line as a whole. This required a separate working organization on each section and a separate outfit with the exception of the mixing plant which served all the work. General management and overhead of course applied to both sections.

Moles Built by Novel Method at Long Beach, Calif.

Aided by Aprons on Cars, Single Trestle Serves Fill 110 Ft. Wide—Heavy Rock Shoved From Flat Cars by Power Shovel

THE city of Long Beach, Calif., has under way an extensive harbor project involving the construction of moles, bulkheads and a breakwater grouped as parts of a joint scheme of port development in which the federal government and the cities of Los Angeles and Long Beach are all to participate. The part of this work for which a $3,500,000 contract was awarded last year by Long Beach calls for between 1,600,000 and 2,000,000 tons of granite to be put in at the rate of 2,500 tons per day. This is said to be the highest rate of delivery ever required on work of this kind.



RELATIVE LOCATION OF MOLES AND BREAKWATER
Drawbridge over harbor entrance in left foreground. End of Long Beach municipal pier in left background

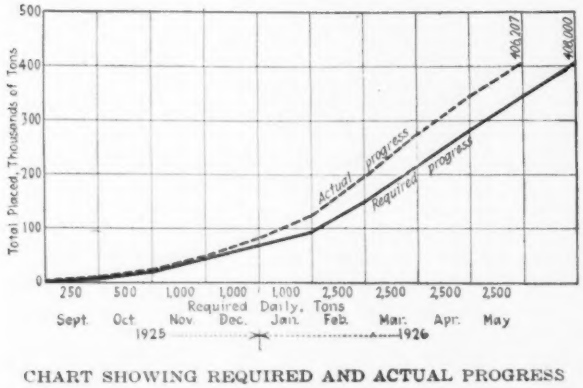


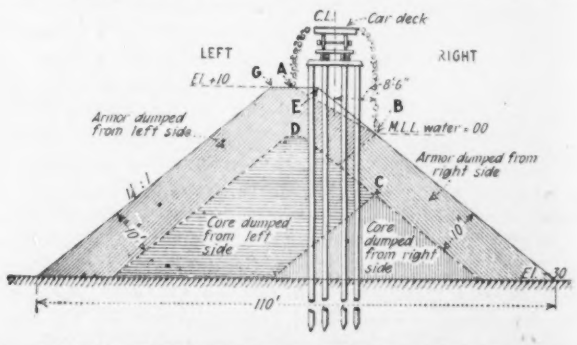
CHART SHOWING REQUIRED AND ACTUAL PROGRESS

Work started Aug. 31, 1925, and the contract calls for its completion in February, 1928. However, if the present rate of progress continues the job will be completed some time in the fall of 1927. Particular interest attaches to the system of placing rock, which made it possible to do the work successfully with only one trestle, and to the method of unloading rock from flat cars with a power shovel. On June 1 the job as a whole was 23 per cent completed and rock was going at the rate of 75,000 tons per month.

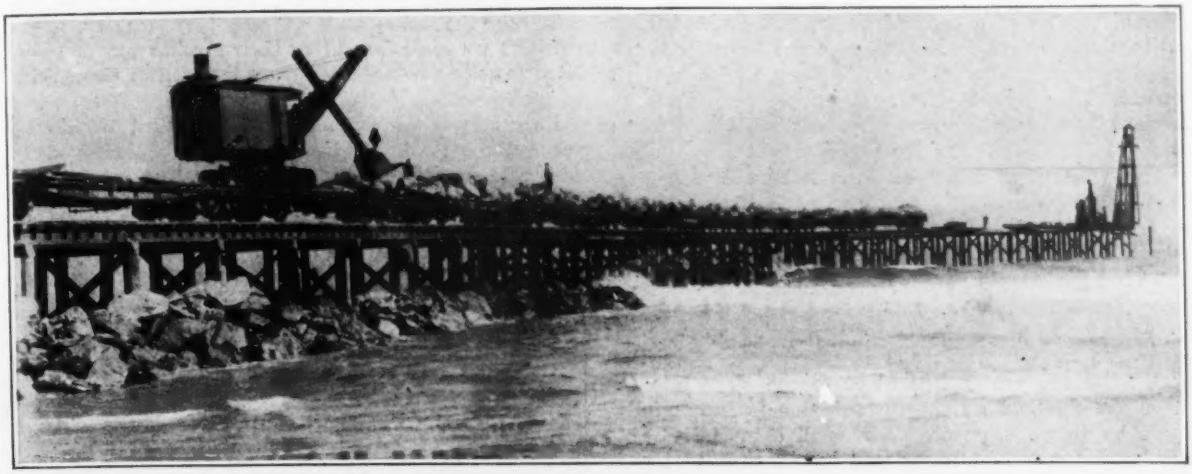
The several structures are of the rubble mound type and extend varying distances from shore into water with a maximum depth of about 30 ft. The finished top of the structures is at El. +10, thus making a maximum fill of 40 ft. The side slopes are approximately 1¼ to 1, so that with a top width of 10 ft. the maximum width of the base is 110 ft. The total length of the several structures being built under the present contract is 14,000 ft.

Suitable granite for this work could be had only from inland quarries about 80 miles from the work, thus requiring a rail haul. The method of placing the rock, therefore, had to take into account the equipment available from the common carrier doing the hauling. A total of 350 cars was required for the rate of placement specified and this precluded the use of any special equipment. In general, the job was predicated on the use of standard flat cars with double side boards, though some 45 Clark air side-dump cars are found to be a valuable adjunct.

Since the use of any type of crane to unload the rock would have required two trestles, endeavor was



SECTION OF SINGLE TRESTLE SERVING WIDE BASE



WORK ON THE WEST MOLE IN AN EARLY STAGE

made to work out some more simple method of placement. A scheme requiring only a single-track trestle was adopted and is said to be an unqualified success. The trestle used in this scheme, shown in the accompanying drawing, connects at its shore end with the common carrier and is built 8½ ft. off the center line of the mole at an elevation that put the car deck 12 ft. above the finished structure.

In order to avoid the danger of damage from falling rock it was necessary to drive the piles plumb. Four piles were used in each bent and were drifted to 12-ft. caps. The length of the piling varied up to 75 ft. The only bracing possible was sway braces from low water to the caps but by keeping the fill uniform on both sides of the trestle at the start no trouble has been experienced in the trestle being shoved out of line.

When a trainload of rock is ready for the trestle the brake staffs are removed and to the train is attached a flat car carrying a ¾-cu.yd., crawler-mounted power shovel, with full swing. The treads are 8½ ft. wide over all, which permits travel on the standard flat car deck. The first work of the shovel is to raise the side boards, which is done by placing a sling round the side board and hooking one end over a dipper tooth. Raising the dipper pulls the side board up and the shovel then swings through a half circle to drop the boards on the empty behind. Stakes are handled in the same way.

SUBMARINE STRUCTURES NOW BUILDING AT LONG BRANCH

Designation	Length, Ft.	Total Rock Required, Tons	Percentage Completed June 1, 1926
Outer breakwater	6983	1,210,000	0.24
East mole	2767	175,000	59.2
Entrance basin bulkhead		111,000	18.2
West mole	2163	110,183	98.9
West bulkhead	1600	71,000	83.5
East bulkhead	1600	58,000	34.5
Entire job			22.9

UNLOADING ROCK WITH A POWER SHOVEL
Note that dipper is blanked off and merely shoves the rock overboard.

The shovel then noses into the rock and, making no attempt to lift any of it, simply shoves it off the car. As the rock is unloaded the shovel moves ahead. As the shovel moves on from car to car the empties are re-equipped with their brake staffs and side boards to be ready for the return trip to the quarry. Fifteen minutes is the time ordinarily required to unload each 50-ton car.

The power shovel is a regular standard type B Erie, the only special feature being in the bucket which is blanked by a plate set in just back of the teeth so no rock can get into or pass through the dipper. Two of these shovels are on the job and are daily moving rock exceeding 15 tons in weight although the shovel itself weighs only 17½ tons. As the shovel works equally well in either direction it is possible to cut out and remove the empties behind it and set in another trainload while the shovel is unloading the last car ahead. Thus the shovel can work through two trainloads with only the interruption required to swing and move back across the last car of the first train.

The structures vary somewhat in cross-section but in

general consist of a core of quarry-run rock ranging up to about 5 tons in weight, armored with 10 ft. of large rock on either side ranging up to 15 tons in weight. Experiments with rock dropped from the cars as described in the foregoing showed that it struck the water in a line 8½ ft. from the trestle center line.

The dumping of small core rock is done equally well from either side of the trestle up to the point *C*, thereafter from the left side only up to point *D* which completes the core. Armor rock is then dumped equally from both sides up to point *B*, thereafter from the left side only to point *A*. At this point the Clark air dump cars are used in order that their extension aprons and controlled motion will make it possible to place the rock from the center line at *A* to the slope line *G*. Thus the final fill on the distant side is successfully made by this equipment. The small area *A-E-B* not reached by gravity is completed by dumping material at *A* above finished grade and pulling it into place by a line from the shovel passing through a snatchblock on the piling.

Using two such unloading units, the average for both has been about 3,000 tons per 8 hr. Thus far the 8-hr. record has been 4,200 tons. After nine months of operation the work is now about 15 per cent ahead of schedule and this contract 25 per cent completed.

The contract is held by the Hauser Construction Co. and work is being done under the direct supervision of K. B. Kumpe, vice-president and general manager. Col. E. N. Johnston is consulting engineer for the city of Long Beach and R. G. McGlone is construction engineer.

Setting Time of Cement Indicated by a Machine Operation

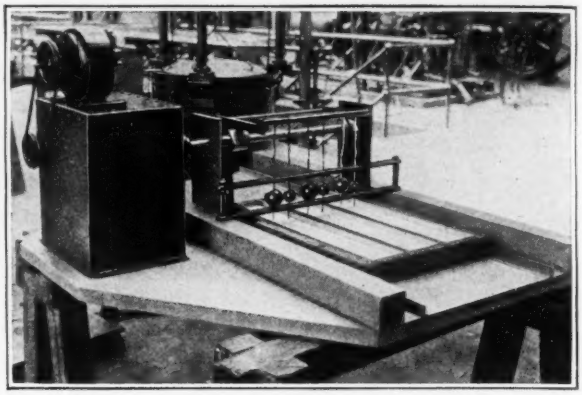
Apparatus Designed by University of Minnesota Student Automatically Performs Gilmore Needle Test

By A. A. Jakkula
College of Engineering and Architecture, University of Minnesota

While doing some research work under the direction of M. B. Lagaard, professor of structural engineering, University of Minnesota, the author found it necessary to devise some method of determining the time of set of cements automatically. The usual method as specified by the A.S.T.M. requires constant attention by the observer and is often an irksome task on slow-setting cements. The machine shown in the illustration was designed and constructed under the direction of the author at the Experimental Engineering Laboratories, University of Minnesota. Several suggestions for its construction were obtained from the Hill setting-time machine. The machine as designed consists essentially of a cement sample tray which is moved periodically under a set of Gilmore testing needles, both the movement of the tray and the raising and lowering of the needles being effected by cams on a governed-speed shaft. In the illustration three samples are being tested simultaneously.

Method of Operation—The galvanized sheet-metal trays, 30x4x½ in., are placed on an angle-iron track. Racks on each side of the tray carrier, cut with eight teeth per inch, are engaged by ratchets operated from the outside pair of cams on the main cam shaft, thus effecting the movement of the tray carrier. The ratchets are so designed that their strokes may be regulated so as to govern the distance traveled by the carrier at each moving.

Each tray is moved under a standard set of Gilmore needles, the needles being connected by flexible cords with a horizontal bar. This bar is raised and lowered by means of a second pair of cams on the main shaft. The two sets of cams are so timed that the needles are lowered and raised while the trays are stationary.



APPARATUS FOR AUTOMATICALLY INDICATING CEMENT SET

The camshaft is operated by a ⅛-hp. motor through two sets of worm-wheel drives, each with a ratio of 1 to 120. Thus the speed of 1150 r.p.m. made by the motor is reduced to drive the camshaft at about one revolution in 10 min. This speed may be varied by changing the ratio of the drive pulleys which connect the motor to the gear box.

In making the tests, the trays are moved a distance of ⅛ in., after which they are stationary for approximately 10 min. During the rest interval the needles are slowly lowered until they rest on the cement samples. The needles act freely since the motion is so slow that they cannot drop onto the samples and of course no driving force is exerted by the flexible cord. Since the samples are stationary during the period of contact, the needles do not drag through the cement.

At first it was thought that the cement would adhere to the needles and prevent them from making a clear impression. Such a possibility was eliminated by not starting the machine until 1 hr. after placing the samples, which was found to be sufficient time to allow the setting process to begin. As the movement of the trays occurs once in 10 min. and the distance traveled is ⅛ in., the time for traversing the full length of the 30-in. trays is about 40 hr. This seems to be sufficient time for any cement to reach the degree of set indicated by the heaviest needle. In the preliminary tests, the point at which the needle ceased to make an impression was so clearly shown that no doubt was felt as to the time the set was reached. A gradual decrease in the depth of impression from the start to the finish showed the process of setting quite distinctly.

The standard specifications of the A.S.T.M. require that the samples be surrounded by moist air during the test. A glass box containing water trays is being constructed around the machine at the present time and the apparatus will then comply with the requirements set forth in the standard specifications.

Los Angeles Builds Superhighway Through Cahuenga Pass

A 72-Ft. Pavement and 200,000 Cu.Yd. of Grading Bring Cost of 6,000-Ft. Concrete Road to Above $550,000

By John C. Shaw
City Engineer, Los Angeles, Calif.

THE heaviest type of pavement in California was used on the Cahuenga Pass road recently constructed by the city of Los Angeles, Calif. This pavement, a section of which is shown by Fig. 1, was unique because of the remarkable construction and traffic conditions on the busy thoroughfare of Cahuenga Ave., and because it was required to conform to the best practice in highway design and construction. A particular structural feature was a retaining wall of reinforced concrete, its design being similar to a multiple arch dam and meriting separate consideration. Rapid construction was another feature. Although the pass roadway was largely blasted through rock as shown by Figs. 2 and 3, the first half (40 ft. wide) was completed in 32 days, with a time limit of 35 days.

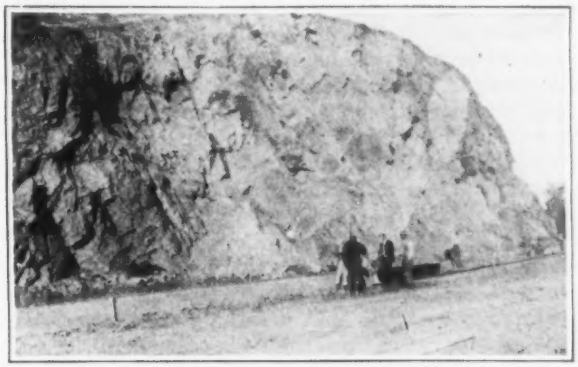


FIG. 3—HARD ROCK CUT, CURB UNDER CONSTRUCTION

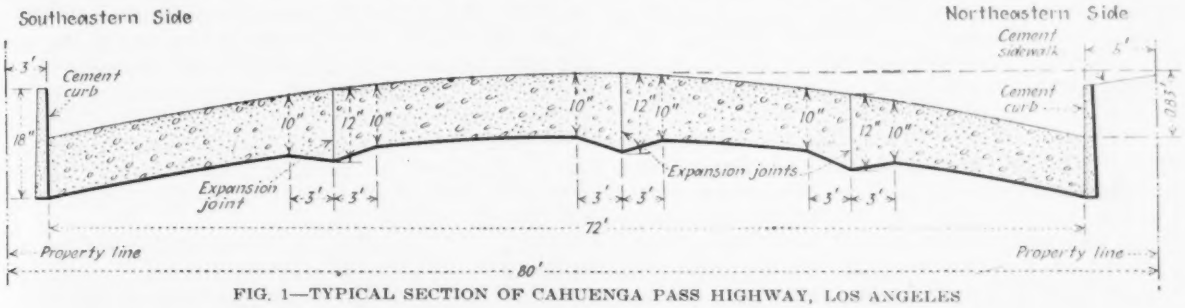


FIG. 1—TYPICAL SECTION OF CAHUENGA PASS HIGHWAY, LOS ANGELES

The remarkable volume and the unusual diversity of traffic passing through Cahuenga Pass was responsible for the speed and the heavy character of the construction. Cahuenga Pass lies along Cahuenga Ave., a heavily traveled artery connecting Hollywood and Los Angeles with the San Fernando Valley as well as with more distant points to the north, such as Santa Barbara and San Francisco. For this reason, this pass in the Santa Monica Mountains is perhaps the heaviest traveled bit of roadway in Southern California. It has been estimated that an average of 35,000 vehicles use this boulevard in a day. This includes all types of hauling—pleasure cars, fast inter-city stage traffic, and the heaviest commercial truckage.

The old roadway had a minimum width of 24 ft., and a maximum grade of 12 per cent. It was paved with ordinary macadam, and many of its curves were too sharp for safety, considering the volume of heavy commercial trackage passing over it. The resulting condition was one of many delays, serious traffic tie-ups, and a menace to public safety. It was useless to consider closing the Pass to travel during construction. It is too vital an artery; it connects Los Angeles with all points north on the main highways and, while it is not the only outlet, it is a principal connection between the city's metropolitan area and the San Fernando Valley. Hence the old roadway was used while the new one was being built.

FIG. 2—ROCK AND EARTH CUT WITH CURB COMPLETED

The new design eliminates all curves of less than 955-ft. radius and all grades of more than 5.6 per cent, and is surfaced with concrete averaging 10.5 in. in thickness. The design followed was four strips, or slabs, each flanging at the edge; the minimum thickness of the concrete being 10 in., the flanges increased to 12 in. thick, as shown in the sketch, making an average thickness of 10.5 in. Between these strips are the customary expansion joints, filled with asphaltum. Standard 18-in. heavy-type curbing is installed on both sides and the improvement includes a 5-ft. sidewalk on the east side.

The dedicated width of Cahuenga Ave. at this location is 80 ft. and the new roadway is 72 ft. between curbs. The concrete was proportioned 1:2:3½ and the specifications throughout meet the high standards for concrete paving required by the Los Angeles Board of

Public Works. The length of the Cahuenga Pass Road Improvement is 6,000 ft., and its cost was $550,000. Funds were provided for the improvement by the city and county of Los Angeles and the City Council created a separate department, known as the Cahuenga Pass Road Department, for the purpose of locating and constructing a new road that would fulfill the necessary requirements for expeditiously handling the immense volume of traffic.

Excavation for the new road was made mainly in solid rock, with the use of steam-shovels to load the dump-trucks. For the greater part of its length, the new line required side hill cut and fill. The excavation was 37 ft. deep at one point. In all, over 200,000 cu.yd. of cut and approximately 50,000 cu.yd. of fill were made. Traffic moved uninterruptedly during construction, because the new site is beside the old location, except for a small portion at the top of the Pass. In order to handle the work on the first 40-ft. strip, within the time limit set, the contractors (Southern Pacific Construction Co.) put on two mixers and worked two eight-hour shifts. This strip was opened to traffic in connection with a celebration staged by the Hollywood Chamber of Commerce Jan. 23, 1926. The last portion of the highway was scheduled to be in place in June.

Rigid-Frame Girder Span in Mountain Highway Bridge

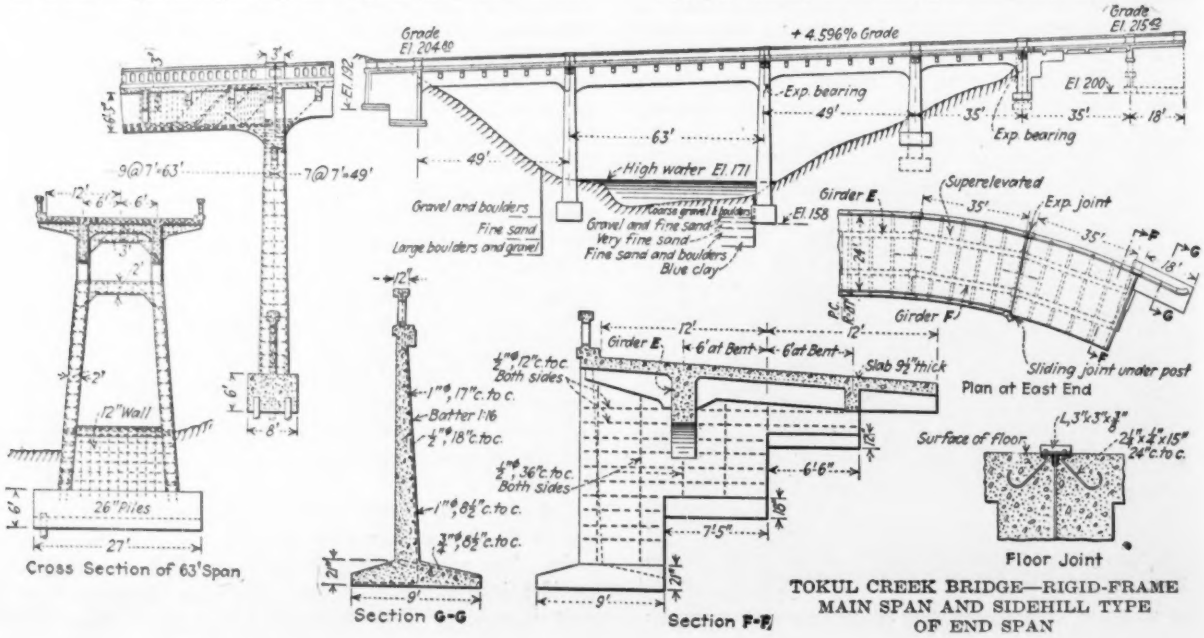
TO SIMPLIFY the expansion-joint construction, rigid-frame construction was adopted for the main span of a concrete girder highway bridge built within the last year across Tokul Creek, King County, Wash., on the highway from Snoqualmie to Issaquah. The bridge is located on a 4.6 per cent grade, and one end is on curve. The height of the structure above streambed and the existing foundation conditions led to the adoption of a concrete girder design, whose central span, 63 ft. between center lines of bents, contains the longest concrete bridge girders yet built in the state. This span was made continuous with its supporting bents in order to permit placing the expansion joints in the shorter flanking spans, where they carry less load. For these joints a new design was used, consisting of three plates, the middle plate having a cylindrical upper surface to allow for adjustment of the bearing under deflection, as described on p. 70.

Tokul Creek is a very rapid mountain stream which often carries much drift and tends to give trouble. The highway is about 45 ft. above the creek bed. The foundation material was found to be large boulders mixed with very fine sand, and was not thought well suited to such foundations, so that a girder construction, with smaller foundation loads and no horizontal thrust, was preferred. The large amount of drift carried by the stream in high water was the reason for making the channel span so long as 63 ft.

Designs with two, three and four girders on the width of the bridge were developed, and the two-girder section was found distinctly cheaper, largely because of the height of the structure. Concrete aggregate is costly because of a long haul to the site, and for this reason a small increase in amount of concrete made a relatively large increase in cost. The girders are spaced 12 ft. on centers; the 24-ft. roadway is cantilevered out by extensions of the floorbeams. The floor slab, 10½ in. thick at center line and 9½ in. at the curb, spans longitudinally between floorbeams 7 ft. on centers. The bents consist of two columns 3 ft. wide at the top and about 5 ft. wide at the bottom, by 2 ft. thick connected in the case of the higher bents by a low cross-wall extending from footing to above ground level, and by a strut under the girder seat, without diagonal bracing.

At the east end of the bridge a sidehill section is used, terminating on a stepped abutment wall, as shown by the drawing. This construction is frequently used on mountain highway structures in Washington, wherever the ground slope is too steep to catch the toe of a fill. In the present case, throwing out the center line of the structure from the hill increased the radius of the approach curve on the uphill side in a very desirable way.

In proportioning the main span no particular account



TOKUL CREEK BRIDGE—RIGID-FRAME MAIN SPAN AND SIDEHILL TYPE OF END SPAN

was taken of the bending stresses in the columns resulting from expansion in the main span, because of the height of the supporting bents and their consequent flexibility.

The bridge was designed under the direction of Charles E. Andrew, bridge engineer of the State Highway Department. James Allen is state highway engineer.

Bottom Recession in Alamo Canal

Scour Occurs When Flow Decreases—Bed Load and Side Feed Appear to Be Controlling Factors

By Glenton G. Sykes
Imperial Irrigation District, Andrade, Calif.

CONTROL of the lower Colorado represents today one of the most acute problems of the Southwest. Much has been written concerning the constantly shifting channel, the rapid building up of vast tracts of the now restricted flood area and the apparent inability of the river to scour and open once more an adequate channel to the sea. Concerning scour, investigations

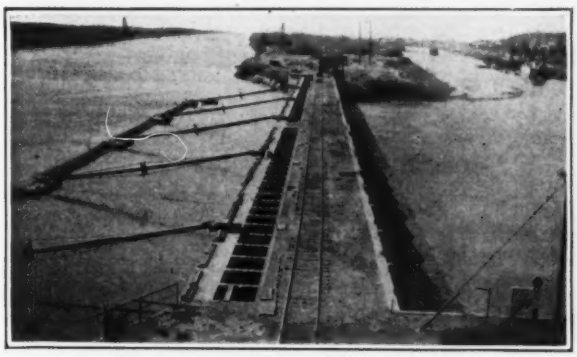


FIG. 1—ALAMO CANAL AT INTAKE
Colorado River at left, canal at right. Intake structure 600 ft. long, containing 75 gates of flashboard type.

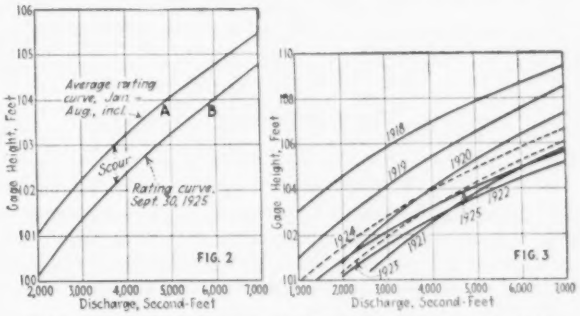
recently made on the Alamo Canal have yielded some rather peculiar and, it is hoped, interesting results.

The Alamo Canal is about 60 miles long, varies in width from 100 to 400 ft., and carries all the water used for irrigation purposes in the Imperial Valley. Its general course follows an old river bed. The entire country traversed is alluvial in character; the canal's fall is gentle, being little more than one foot per mile.

A gaging station is maintained on the canal about 1½ miles below the point of intake. Sets of soundings and readings for the computation of discharge are taken twice daily. From these readings, rating curves have been constructed and their movements have been carefully watched and recorded. There is no well defined control below the gaging station and the shifting up or down of the rating curve is an index of a changed condition in the channel below. These changes are checked by a long line of gages.

Beginning about Feb. 1 with a discharge of say 2,500 sec.-ft., the water demand gradually increases, attaining its maximum about July 1 with a discharge of 7,000 sec.-ft. It would be natural to suppose that as the discharge increased the scour of the bed would increase in like proportion, but the rating curves seem to show that such is not the case. The maximum scour takes place at a much reduced flow. The explanation probably is:

The water surface is well depressed below the general land level, and high vertical banks border the canal for



FIGS. 2 AND 3—RATING CURVES FOR ALAMO CANAL, INDICATING SCOUR EFFECTS

many miles. The canal runs at maximum capacity, 6,500 to 7,000 sec.-ft., for about three months during summer, and the banks cave or slough down with a sugarlike rapidity, producing a heavy side feed. Much of this material is too large to be carried in suspension, and moves along as bed load. Even under these conditions it is found that the canal bottom remains comparatively stable, neither scouring nor filling to any marked degree. A characteristic of the sloughing banks is the formation of berms extending some distance out into the stream and lying well below the surface. During the latter part of August, the quantity flowing in the canal is gradually reduced, and there comes a stage at which, owing to the berms, there is a general and rapid recession of the water away from the standing banks. The side feed is suddenly cut off, the bed load is greatly reduced, and the resulting condition is one favorable to general scour, which takes place at a discharge of about 4,000 sec.-ft. During the month of September, 1925, the entire canal scoured down about 1 ft., after which a state of grade seems to have been reached and the bottom was once more stationary. Further, this scouring took place at a time during which the percentage of solid matter in suspension was abnormally high, showing the bed load to be the controlling factor.

In Fig. 2 *A* is a rating curve drawn from plottings of all measurements from January to August. Curve *B* shows the position to which the rating curve had shifted and become once more stationary by Sept. 30. The space between *A* and *B* represents 30 days' scour.

Fig. 3 shows a series of rating curves for the years 1918 to 1925. Each was constructed upon data for the entire year and represents the average position of the curve for the year. They show very plainly a steady recession of the bottom up to 1922, after which it apparently ceased; the curves for 1923, 1924 and 1925 oscillate over a common region, and a condition of balance has evidently been attained. Further deepening of the channel to any great degree is unlikely.

A condition met with during very high stages, and one which gives considerable trouble, is a pulsating effect at the main check, some thirty miles below the intake. It has been definitely proved that these variations do not have their origin at the point of intake, and it is very probable that they are due to large quantities of material entering the canal at localized points, tending to choke it and increase the grade temporarily.

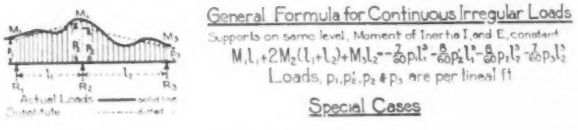
From Job and Office

HINTS THAT CUT COST AND TIME FOR THE CONTRACTOR AND ENGINEER

General Three-Moment Equation

By J. W. Pearl
Consulting Engineer, Chicago

IN AN effort to determine the distribution of pressure to the soil below a continuous footing under three or more columns, the writer was confronted with a problem upon which all text and reference books at hand were silent. No uniform pressure, or uniformly varying pressure, assumed would simultaneously satisfy the "Three-Moment Equation" and the known column loads.


General Formula for Continuous Irregular Loads
Supports on same level, Moment of Inertia I and E constant
$M_1l_1+2M_2(l_1+l_2)+M_3l_2=-\frac{7}{60}p_1l_1^3-\frac{8}{60}p_2'l_1^3-\frac{8}{60}p_2l_2^3-\frac{7}{60}p_3l_2^3$
Loads, p_1,p_1',p_2,p_2' & p_3 are per lineal ft
Special Cases
For p_1 and $p_3=0$
$M_1l_1+2M_2(l_1+l_2)+M_3l_2=-\frac{8}{60}p_2'l_1^3-\frac{8}{60}p_2l_2^3$
For p_2' and $p_2=0$
$M_1l_1+2M_2(l_1+l_2)+M_3l_2=-\frac{7}{60}p_1l_1^3-\frac{7}{60}p_3l_2^3$
For $p_1=0$ and $p_2'=p_2$
$M_1l_1+2M_2(l_1+l_2)+M_3l_2=-\frac{8}{60}p_2'l_1^3-\frac{8}{60}p_2l_2^3-\frac{7}{60}p_3l_2^3$
For p_2' and $p_3=0$
$M_1l_1+2M_2(l_1+l_2)+M_3l_2=-\frac{7}{60}p_1l_1^3-\frac{8}{60}p_2l_2^3$
General - p_1,p_1',p_2 & $p_3>0$
$M_1l_1+2M_2(l_1+l_2)+M_3l_2=-\frac{7}{60}p_1l_1^3-\frac{8}{60}p_2'l_1^3-\frac{8}{60}p_2l_2^3-\frac{7}{60}p_3l_2^3$
For $p_1=p_2'$ and $p_2=p_3$ Uniform Load on each span
$M_1l_1+2M_2(l_1+l_2)+M_3l_2=-\frac{1}{4}p_1l_1^3-\frac{1}{4}p_2l_2^3$
For $p_1=p_2'=p_2=p_3=p$ Uniform Load on both spans
$M_1l_1+2M_2(l_1+l_2)+M_3l_2=-\frac{1}{4}p(l_1^3+l_2^3)$
For loads uniform & spans equal $M_1+4M_2+M_3=-\frac{1}{2}pl^3$ $M=\frac{1}{12}pl^2$
" " " " " and $M_1=M_3=0$, $M_2=-\frac{1}{8}pl^2$

THREE-MOMENT EQUATION DIAGRAM

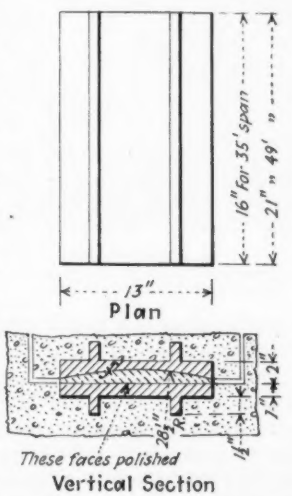
An irregularly distributed pressure, represented by the full irregular line in the upper diagram on the accompanying chart, was assumed; with pressures so distributed that their center of gravity would fall on a line through the center of gravity of the loads on columns R_1, R_2, R_3,—inverted for convenience. Average lines, shown dotted, were then drawn through the profile of the pressures and the general formula was developed, as given at the right.

It was then noted, that by obvious substitutions in the general equation, all the special cases given on the chart herewith could be written; also, that for spans of equal length and uniform loads per lineal unit, the general formula reduces to the expressions given in all reference books; a coincidence that inspires confidence in all of the formulas previously stated.

In solving a case of footing pressures it is obvious that an infinite number of profiles can be assumed that will satisfy the conditions mentioned. It is equally obvious that there can be no material variation in the pressures, p'_2 and p_2. Also that in the case of a continuous girder of uniform section the moments M_1, M_2, M_3, should be made as nearly equal as possible while adhering to the condition that the center of gravity of the column loads and soil pressures must coincide.

Three-Plate Bronze Expansion Bearing for Concrete Beam Bridges

A NEW design of expansion joint has been used during the last year in a number of concrete beam bridges built by the State Highway Department of Washington. It is a three-plate bearing, with lower and upper plates anchored into the concrete seat and girder respectively, and an intermediate sliding plate with lower face horizontal and upper face cylindrical to permit adjustment as the girder deflects. All plates are phosphor bronze. The dimensions shown in the adjoining sketch are those used in the expansion joints of a new bridge over Tokul Creek, 3 miles north of Snoqualmie, the bearings carrying 35- and 49-ft. spans of a two-girder bridge with 24-ft. roadway.



THREE-PLATE EXPANSION JOINT AS USED IN TOKUL CREEK BRIDGE

Charles E. Andrew, bridge engineer of the State Highway Department, says of this joint that it is an advance over rocker joints, whose line contact is an objectionable feature under heavy spans, and is better than plain flat plates because the curved surface avoids the increase of pressure at the forward edge of the plate at the time when girder deflects, which takes place in case of the use of straight plates. The latter advantage is particularly important in spans of 40 ft. and more. The joint is permanent because made of bronze. No asphalt filling or galvanizing is necessary as with rockers. Experience has shown that asphaltic filler in rocker pockets hardens in the course of time and tends to make the joint immovable. The new design moreover is cheaper than a rocker bearing and is easy to set during construction.

Friction tests showed that moderately polished bronze on bronze would not have a friction coefficient above 0.3 under the worst conditions. The secondary stresses due to friction of this amount are not excessive under the heaviest girder spans so far used.

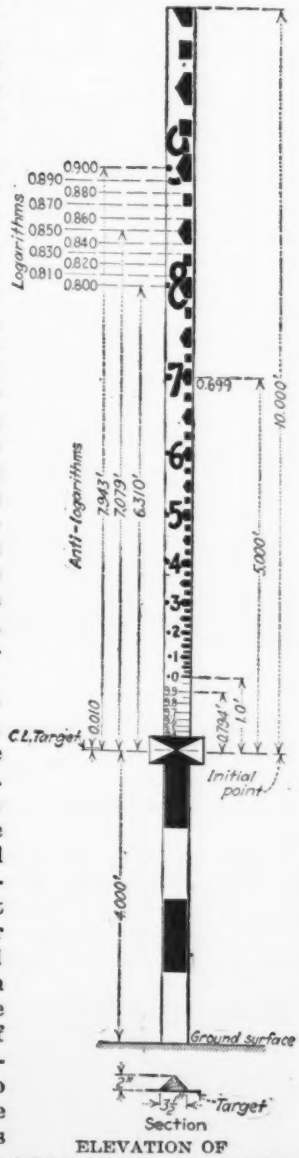
Logarithmic Stadia Rod for Topographic Work and Area Measurements

By John R. Jahn
Irrigation Engineer, San Francisco, Calif.

THE stadia rod illustrated herewith gives rod readings which are the logarithms of the number of feet intercepted on the rod by the stadia wires of the transit. This feature assists in the reduction of field notes. The chief advantage of this scale, however, lies in the improved visibility of the divisions on the rod's scale at the transit.

It is to be noticed that the rod has a target, on which the lower stadia wire is to be set, and that the divisions increase in width proportionately with increasing distance from the target. As the stadia rod moves away from the transit the upper stadia wire of the transit registers farther along the rod cutting the larger divisions. Due to this property of proportionality these registering divisions appear through the transit to have constant width. This reduces the strain in taking distant shots and makes rapid readings at all reasonable distances possible because the observer's eye becomes accustomed to the constant widths of interval. Likelihood of error in readings is thus reduced.

The 10-ft. scale is normally adapted to distances under 1,000 ft., when the upper wire alone is used. The middle wire, which divides equally the space between the lower and upper wires, always registers on the stadia rod at —0.301 below the upper wire, that is, at log ½, and when the rod is more than 1,000 ft. away from the transit, the doubled half interval is very simply obtained by adding 0.301 to the reading of the middle wire. In this way shots out to 2,000 ft. are obtained. This addition becomes automatic and is more simple than the usual multiplication by two.



ELEVATION OF LOGARITHMIC STADIA ROD

In reading cross vertical angles by the usual method the writer found that accurate results were obtained by shifting the lower stadia wire into the position formerly occupied by the middle wire, and setting the lower wire on the target of the stadia rod. Thus both rod intercepts and vertical angles were read at once. This put the cross wires into the upper part of the visible field, but by adjusting the eyepiece holding ring the field was again centered. The field work was thus reduced and simplified. The elevations computed for each shot then referred to a height of instrument 4.01 ft. below the actual level of the transit's horizontal axis.

Office Calculations—Reduction of notes to give elevations above any given datum is simplified necessitating but one setting of the rod interval and vertical angle. To reduce the logarithmic rod readings to logarithmic horizontal distances correcting numbers corresponding to observed vertical angles are also shown on the nomographic computer. The logarithmic horizontal distances are plotted using logarithmic scales similar to the field rod and of the required reduced size to give maps of the desired scale. In this way no reduction of logarithmic readings to feet is necessary, the final map being a reproduction of the field surveyed at the reduced scale.

Rod Construction—The following method was used in preparing the stadia rods. A 4x4-in. stick of kiln-dried cottonwood was ripped on the diagonals of the square giving four rods of triangular cross-section. These were cut to lengths of 14 ft., the corners rounded and the dressed faces painted with linseed oil to seal the pores. The 3½-in. face of each was given a coat of flat white enamel and the graduations painted thereon. The first 4 ft. were made alternately white and black, the 4-ft. mark being taken as the initial point for the logarithmic scale. This scale was laid out using a table of anti-logarithms for the values. The graduations give the first two figures of a three-place logarithm, the last figure being estimated by eye as tenths of the division. Since the divisions under either stadia wire appear of constant width this estimation of tenths is simplified.

The target is an aluminum plate painted as shown and fastened to the face of the rod 0.01 above the initial point, that is, at 4.01 ft. from the bottom of the rod. The object of this is to add automatically the "$f' + c$" correction to the rod readings.

These rods are light and stiff in the wind and a rodman can easily hold one over his head to give shots behind low obstacles or in local depressions.

Areas—The logarithmic feature is very useful in estimating acreage in reasonably flat country. The transit is set up in the middle of the field and a rodman walks around the border giving rod readings at all angle points. Two adjacent rod readings designate a triangular section of the field. Their sum plus the sine of the included angle plus a constant (9.060) is the logarithm of the area of the section in acres.

The algebraic sum of all the triangular sections is the area of the field. By using a table of three-place antilogs and sines, the area of the field can be known as soon as the last rod reading is taken.

The writer developed the logarithmic rod and its aids and has used it extensively for some time. It has been found to be very fast and accurate. Recently in flat open country using two rodmen, he read and recorded stadia shots at the average rate of 3½ shots per minute for 2½ hours. The readings included (a) rod readings, (b) vertical angles, read with an improved gradienter attachment to an equivalent of 20 sec., and (c) bearings, read to the quarter degree. The resulting 500 shots were subsequently reduced to sea level elevations in 85

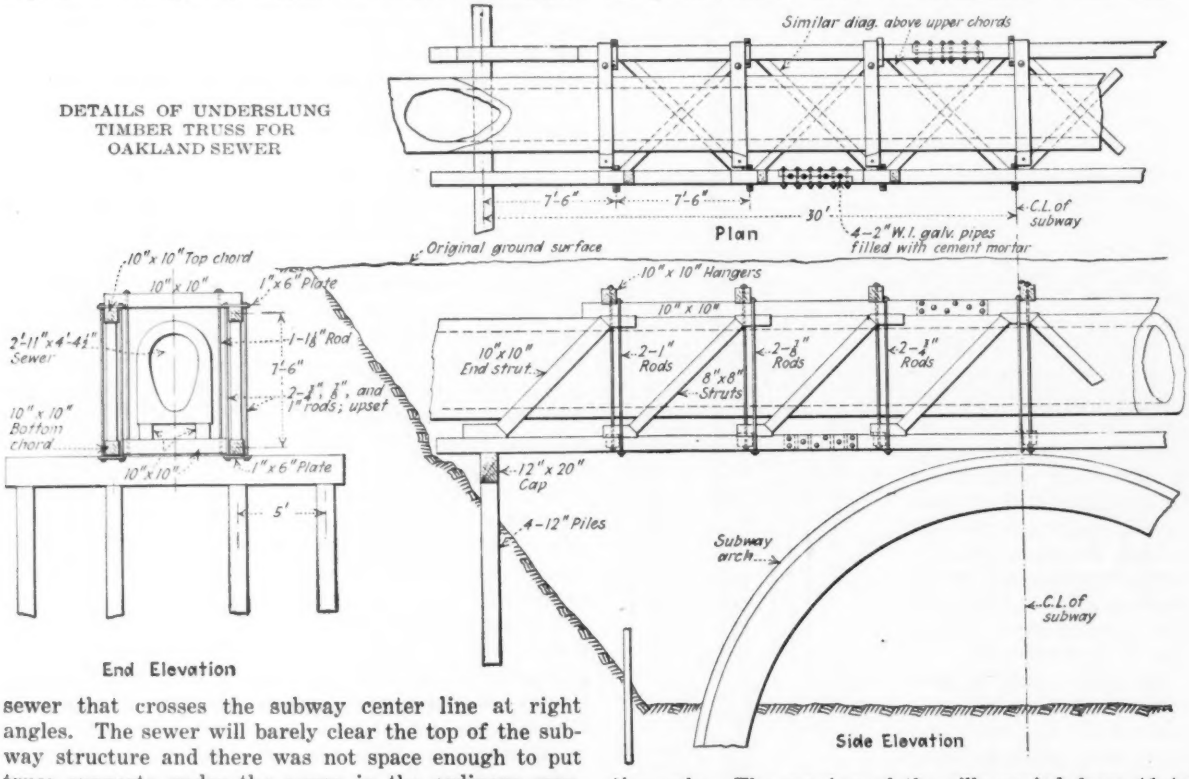
min. The area covered by the setup was about ninety acres. The method has been used for preparing contour maps, for taking profile and cross-section for grades and for the estimation of areas.

The system has not been patented and the writer recommends it to anyone interested.

Sewer Carried on Novel Truck Across Subway Excavation

IN excavating for the subway that is now being built under the estuary at Oakland, Calif., it was necessary to provide a temporary support for a 4-ft., egg-shaped sewer that crosses the subway center line at right angles. The sewer will barely clear the top of the subway structure and there was not space enough to put truss supports under the sewer in the ordinary way. Accordingly a truss was built up with secondary hanger rods that carried the weight of the sewer suspended from the upper panel poin as shown in the accompanying illustration.

DETAILS OF UNDERSLUNG TIMBER TRUSS FOR OAKLAND SEWER



The truss was designed for the subcontractor, Robinson, Roberts & Rohl, by A. R. Baker. George A. Posey is chief engineer of the estuary subway.

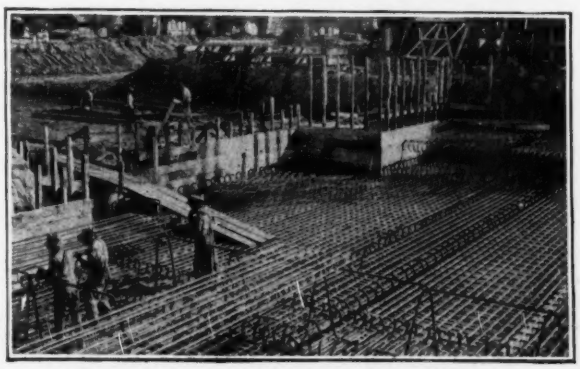
Placing Heavy Concrete Mat for New City Hall, Pasadena

BY MICHAEL J. PHILLIPS
Pasadena, Calif.

WHAT is said to be the largest reinforced-concrete mat ever poured on the Pacific Coast has recently been completed at Pasadena, Calif., as a foundation for the new city hall, one of the buildings of the Pasadena Civic Center project. The mat is about 100 x 104 ft. in plan, 5 ft. thick, and contains 1,950 cu.yd. of concrete which was placed in a continuous pour extending over a period of 84 hr. The mat is reinforced by 160 tons of 1¼-in. square deformed bars placed in two grillages, one 6 in. from the top and one 6 in. from the bottom of the mat. Each grillage consists of two layers of 1¼-in. bars laid at right angles.

In the bottom grillage the bars were spaced 12¾ x 7½ in. on centers and were supported on concrete sills, 6 in. wide by 4¾ in. high. These sills, which were built to the grade of the underside of the steel before any steel was placed, extend across the foundation in one direction only. The spacing of the sills varied from 11 to 14 ft.

Steel near the upper face of the mat was supported by "chairs" consisting of reinforcing bars bent and fastened in position by means of guy wires as shown in the accompanying picture. A series of runs of these supports across the foundation served the upper rein-



WORK UNDER WAY ON SECOND GRILLAGE
Note method of placing the "chairs" for supporting upper steel grillage.

From Job and Office

HINTS THAT CUT COST AND TIME

From Job and Office

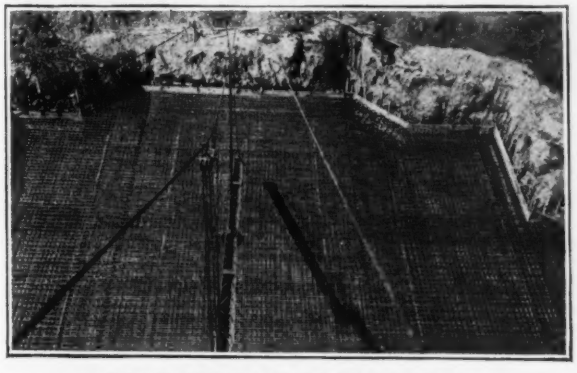
FOR CONTRACTOR AND ENGINEER

forcing grillage much as the sills supported the steel near the bottom. In the upper grillage the bars were spaced 4½ x 7½ in. on centers.

Special attention was given to the aggregates; the proportions were determined by sieve analysis, aiming at the maximum density of concrete and a minimum of water. The selection was 1 part of cement, 1.85 of sand, 1.84 of gravel ranging from ¼ to ¾-in. mesh, and 2.31 of 2-in. crushed rock. To this was added 1 per cent by weight of diatomaceous earth, bringing the mix to a 1:6 ratio.

The inundation method was used; rock and gravel were measured in separate adjustable batches and the sand was maintained in a constant volume, adjustment for any difference or fluctuation of the materials being made by changes in gravel and rock proportions.

When the steel and forms were ready for the pour adjustable chutes from the mixing plant were arranged



PART OF MAT WITH ALL STEEL IN PLACE
This view taken from the tower just before pouring began

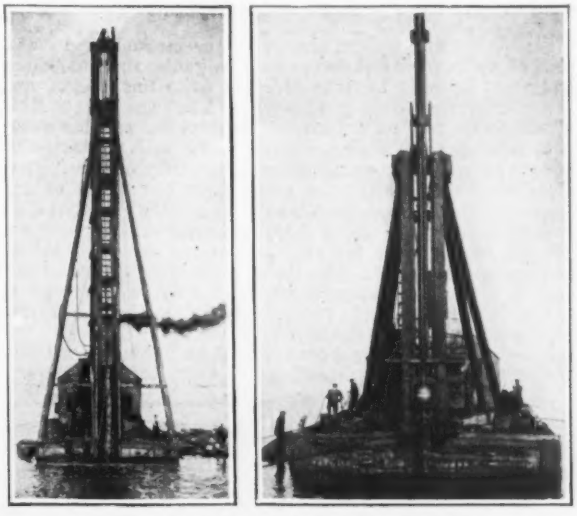
to avoid any interruption to pouring and so that the continuous pour could always be on a fresh surface. Each crew, which worked 8 hr., consisted of two men in the cement house, two on the mixer platform and eight on the mat, handling the chute and tamping.

The contract for this work is held by the Orndorff Construction Co., Los Angeles. Harvey W. Hincks is construction engineer in charge of the civic center project. Acknowledgment of co-operation in getting these data together is made to Walter Putnam, chief inspector, and Walter Zuetel, deputy inspector, Pasadena building department.

Unusual Accuracy in Cutting Piles Under Water

Over 13,000 piles supporting the piers of the Central R.R. of New Jersey bridge across Newark Bay were driven 23 ft. below low water by submarine pile hammers and then cut off with a floating saw rig so that the maximum variation of piles in a group did not exceed ¼ in. Such exactness was necessary since the floating cofferdams that were used for constructing the piers on top of the groups of piling used a reinforced-concrete bottom instead of the conventional timber grillage. The entire substructure work on this bridge was described in *Engineering News-Record*, Feb. 4, 1926, p. 184.

The illustrations show the pile driving and pile-cutting rigs the latter consisting of an 800-ton barge fitted with vertical leads in which is fastened a 12-in. H column. This slides up and down by means of a differential hoisting tackle of high multiplication, a 1-ft.



PILE DRIVING AND CUTTING OUTFITS
ON NEWARK BAY BRIDGE

movement of the hoisting line corresponding to only ⅛-in. change in level of the saw. A vertical shaft 50 ft. long resting in bearings on this H-beam carries the saw at its lower end. A continuous check of the pile elevations was kept by a wye-level sighting on a white mark on the shaft.

Chart for Converting Kutter's "n" Into Hazen and Williams "C"

We will supply to readers who wish it a larger scale reproduction of the original chart for converting Kutter's *n* into Hazen and Williams' *C* which was incorrectly reproduced in articles in our issues of May 27, p. 870, and June 10, p. 954. The chart as there given can not be used because a vertical axis was omitted, and the two portions of the figure should be farther apart. In asking for the correct chart, address The Editor, *Engineering News-Record.*

Job and Office Notes

Because of the Many and Various Materials Encountered in excavation, and a limited width of right-of-way on the new Coast Highway through the Malibu Ranch, it has been necessary to employ numerous slope angles for cut banks, ranging from ¾ to 1, to 1½ to 1, reports Division VII, of the California Highway Commission. In checking the various slopes, a 5-ft. straightedge is employed with cleats attached at the proper angle. They are arranged in such a way that when a cleat is held horizontal as shown by an attached level, the straightedge is on the proper slope. The straightedge is provided with six cleats on each side and can be used to measure the angle of twelve different slopes. —*California Highways.*

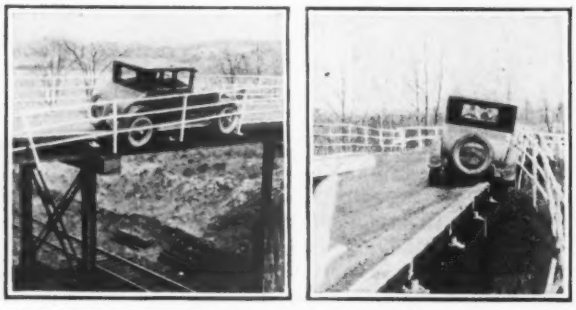
Letters to the Editor

A FORUM FOR DISCUSSION OF VIEWS OF ENGINEERS AND CONTRACTORS

A Case of Curb-Climbing

Sir—What any radical change in the methods and materials of civilization will do can only be guessed at in advance and what actually happens is often quite unexpected, and not always immediately apparent. That the substitution of rubber for iron as a material for tires for vehicles would stimulate pleasure riding, on one hand, and permit much lighter construction on the other, was fairly obvious. That the change would alter the wheel from the friend of dry macadam to its bitter enemy, sucking out the essential dust packing instead of forcing it in, was somewhat unexpected, but the results were too serious and too extensive not to be discovered at once. But there is another feature of the rubber tire which the comparatively soft balloon type is emphasizing; while of great importance, it is but just beginning to receive proper consideration.

A metal tire striking a curb almost at right angles tends to shear off rather than climb, even though the curb is quite



CAR HELD BY RAILING AFTER CLIMBING CURB GUARD

low; a rubber tire, on the contrary, particularly if it is of the recent softer types, will readily climb the same curb when all but parallel to it, and it is a question if some tires do not climb better this way than at a much more abrupt angle. This has its advantages when getting out of tight parking parallel to the curb, but too little attention is being given to its relation to curb and guardrail height on bridges and at other points where a climb over may result unpleasantly if nothing worse.

A notable case was that of the Connecticut River bridge at Springfield, Mass., where, as may be remembered, the automobiles climbed the 6-in. curb and smashed the ornamental concrete balustrade on the river side of the sidewalk so frequently, and with such costs for repairs, not to mention the annoyance of the unfortunate foot passengers in the near vicinity, as to cause a three-cornered discussion (speaking with moderation) between the city, the state, and the designing engineers, resulting eventually in raising the curb height to 9 in. by bolting a wood guardrail on top of the old curb.

The photographs show the results of a particularly interesting case of such curb-climbing. The bridge forms the central part of an S, with rising grades and a right-angled turn to the left approaching each end. The driver, operating apparently at a reasonable speed, and with due care, dozed for a moment, but must have unconsciously all but made the turn, for while he said that his last recollection before he was waked by the car striking the last post was that he was on the approach some little distance away, his front right mudguard had only rubbed the wooden fence seen in one picture, and except for the scratched surface was uninjured, although the car slid some forty feet thereafter.

The pipe rail posts rise from sockets on the I-floorbeams, and there is a clear space of about 2¼ in. between guardrail and post. The heavy rubber shoe forced down into this, wedging the posts over and out, so that not one touched the car; there may have been some mischief done to the under gear as a result of the slide, but as far as could be seen the scratching of the enamel on the mudguard was the only injury to the car.

Springfield's answer, increasing the height of the curb or guard, may be all right when there will be no stepping up or down, although it is rather an abrupt proceeding, not to say brutal, but for a curb between a walk and a roadway there is a limit set by personal safety. Whether 9 in., which is about as much as can be reasonably allowed, is sufficient, is a question, and it would seem that the importance of the subject warrants an amount of attention it apparently has not received, to determine if some form of top, as for example, a half round bead overhanging the face, may not stop climbing at least as effectually at such curb height as safety to the pedestrian makes practicable.

CHARLES RUFUS HARTE,
Construction Engineer,
The Connecticut Co.

New Haven, Conn.,
June 11, 1926.

Disinfectants and Sewage Nitrification

Sir—I make the following comments upon Mr. Cohn's experiments on sewage chlorination and the discussion of his results by Messrs. Eddy, Mohlman and Rudolf in your issues of June 10 and 24, pp. 943 and 1035. Similar work was carried on by us at Lawrence many years ago and is summarized on pp. 362 and 363 of the report of the State Board of Health of Massachusetts for 1908. In one of these experiments bleaching powder was mixed with the sewage applied to a trickling filter 8 ft. in depth. It was at first applied at the rate of 5 p.p.m. available chlorine and this was gradually increased to 50 p.p.m.—a much higher rate than in Cohn's work. During the first four months of the experiment the only noticeable change in the effluent from this filter was an increase in chlorine. After four months, however, and when the available chlorine had been increased to 50 p.p.m. the nitrates in the effluent decreased from about 20 to about 7.5 p.p.m. with an increase in the nitrites, and this condition followed for a number of months.

This work at Lawrence followed similar work at the Hamburg Experiment Station as reported by Schwartz in 1906. With the sewage used there, nitrification entirely ceased when bleaching powder equivalent to about 25 to 70 p.p.m. available chlorine was added. In our work the filter to which this treated sewage was applied continued in operation for months with fair nitrification even after 50 p.p.m. available chlorine was applied to the sewage with which the filter was operated. At Lawrence, moreover, even before this, large doses of copper sulphate had been applied occasionally to trickling filters for the purpose of checking fungus growths, etc., by which the upper layers of the filters had become clogged. (See Report Mass. State Board, 1908, p. 363.) Such treatment almost always accomplished the desired results without detrimental effect upon the purification accomplished by the filters; in fact, nitrification was generally increased by destroying the clogging growths. On p. 364 of the report just mentioned a statement was made that all the experiments with disinfectants showed that a filter must become slowly accustomed to the presence of such substances in gradually increasing amounts but when once accustomed to considerable amounts, the process of nitrification would proceed unimpaired. This statement was made following the results of much work with a dozen or more disinfectants or other bodies inimical or resistant to nitrification. An article by the writer and S. DeM. Gage entitled "Disinfection of Sewage and the Effluents from Sewage," given in the Report of the Massachusetts State Board of Health for 1911, presented many data along these lines.

I was interested in Dr. Rudolf's statement that "more likely with lower chlorine application the chlorine was absorbed before it reached the nitrifying organisms because we have shown that nitrification takes place mostly in the bottom of the beds." This is directly contrary to the Lawrence Station results obtained through many years. These results show that nitrification begins near the surface and increases progressively and proportionately to the depth of the filter. Similar results have been obtained by us when collecting samples from each foot in depth of trickling filters in operation at the Lawrence Station and in the separate operation of filters 4, 6, 8 and 10 ft. in depth. Results similar to ours have also, I understand, been obtained by many English workers along this line.

H. W. CLARK,
Chemist, Massachusetts Department of Health.

Boston, Mass.,
June 29, 1926.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

International Road Congress to Be Held in September

The fifth International Road Congress is to be held in Milan, Italy, Sept. 6-12, with closing exercises at Rome on Sept. 13. There will be excursions to points of interest on Saturday, Sept. 11, and Sunday, Sept. 12.

Simultaneously with the Congress, under the patronage of the Communal and Provincial Administration and the Chamber of Commerce of Milan, an international road exhibition will be held in the grounds of the "Fiera Campionaria" at Milan. It will be opened Sept. 1 and will close on Sept. 20.

Railroad Valuation Hearing Set for January, 1927

The date for the hearing before the United States Supreme Court in the appeal of the United States and the Interstate Commerce Commission against the Los Angeles and Salt Lake Railway Co. from the decision of the federal court for the Seventh District of California has been advanced and set for January 3, 1927. The case involves the question of whether a tentative order of the Interstate Commerce Commission fixing the value of the property of the Los Angeles and Salt Lake Railroad Co. as of June 30, 1914 at $45,000,000 constitutes an "order" under the Commerce Court Act and whether the federal court for the Seventh District of California has jurisdiction to review the order of the commission.

Airplanes to Be Used for Map Work in Alaska

Airplanes are to be used in mapping 5,000 square miles of southeastern Alaska. Little of this region has been mapped, as the difficulties of ground surveys are many. The mountains are rugged and the undergrowth makes passage very difficult. The U. S. Geological Survey has transferred a portion of its appropriation for this work to the Navy, which has assigned some of its experienced fliers and aerial photographers to the work. The Navy expedition has recently left for Alaska, with Lt. B. H. Wyatt in command and Lt. W. M. Dillon as executive officer. A. B. Sargent of the topographic staff of the Survey is with the party. Three planes will be used. Definite surveys are to be made, with a view to producing not merely mosaics but an accurate base map of the whole of the Alexander Archipelago.

With the improvement of photographic apparatus and the perfection of methods by which the data from the photographs are assembled the Geological Survey finds the airplane an invaluable adjunct to its topographic work. An entire unit of the Air Service of the Army has been assigned to the co-operative work with the Geological Survey. Extensive airplane surveys now are in progress in Texas, Delaware, New Hampshire, New York, Illinois and are about to be undertaken in Wisconsin and Missouri.

Engineering Fifty Years Ago

From *Engineering News*, July, 1876

THE waters of Lake Michigan usually stand about two feet (average 1.83 ft.) above datum. During the first part of the present month they have risen to a height of 3.4 ft. above datum, a height unknown during the past 19 years and only exceeded in 1857.

The people of Grand Crossing and South Chicago are much exercised about it, as in many portions of the town the land is but 1½ to 3 ft. above the present surface of the lake. Various plans are recommended for relief, among which is a canal forty feet wide and six or eight feet deep, extending from the Calumet River near the railway bridge, two miles, to the vicinity of Cottage Grove Ridge. We do not desire any corner lots in that vicinity at present.

* * *

We learn from the *Railway World*, that Senator Jones and his associates propose to build a road from Los Angeles, Southern California, to Ogden, Utah, a distance of 686 miles. The road from Los Angeles to the Port of Santa Monica, 16 miles, is now in operation and will be the outlet of the proposed line to the Pacific. This route is shorter by 250 miles, than from Ogden to the Pacific by the Central Pacific Railroad. From Los Angeles two routes have been surveyed to connect with the Utah Southern Railway, the most direct of which runs as straight as possible to Cajon Pass, thence via Camp Cody and the Old Salt Lake wagon road, via Pioche, to the drainage of the Rio Virgin near St. George, in Southern Utah; thence north to a connection with the Utah Southern Railway at Nephi, its present terminus. The Utah Southern is now constructed 130 miles south from Ogden, and will be pushed to the Colorado River in order to reach the coal and iron fields of Southern Utah.

Striking Engineers Win at Chicago

One-day Strike of Engineers in City Employ Gains Them Increase in Salary

Following a one-day strike June 30, the engineers in municipal positions in Chicago went back to work with their request for increased pay granted by the City Council. The latter body remained in session from 2 p.m. to 3:50 a.m. battling over the inclusion of sufficient money in a supplemental budget to care for the engineers. For the first time in several years the recommendations of a strongly intrenched finance committee have been overruled on the council floor. A three-quarter vote is necessary to override the committee, but the friends of the engineers stuck by them and won in the end by inducing the committee to cut the necessary money from other items, the budget having already been loaded to the limit of funds in sight.

More than 500 engineers were involved, including 85 in the building department, 248 in the department of public works and 216 in the board of local improvements. Construction was temporarily halted on a water tunnel, pumping station and street work because of the absence of inspectors and engineers. Department heads remained on the job to care for emergencies. If engineers were required they were available through the headquarters office of the engineers' organization, which is Local 14 of Draftsmen, Architects and Technical Engineers affiliated with the American Federation of Labor. Last year, this same body of engineers quit work as a protest against this "injustice," but returned after one day when the mayor assured them that their salaries would be adjusted. No adjustment was made, however, and the finance committee still failed to provide relief, claiming then as it did last week, that it could not find the money for this particular purpose.

45-Mile Railway Line in Minnesota Authorized

The Interstate Commerce Commission has authorized the construction by the Minnesota Western Railroad Co. of an extension of its present line from Lake Lillian to Montevideo, Minn., a distance of about 45 miles. The railroad company applied for permission to build as far as Dawson, a distance of approximately 57 miles, but the commission refused permission for the extension beyond Montevideo on the ground that the territory beyond that point was adequately served by existing railways. Construction is to start before Dec. 31, 1926, and to be completed by the end of 1927.

Lake of the Woods Level Control by Army Engineers

The Secretary of War has assigned to the Chief of Engineers the work of carrying out the provisions of the convention between the United States and Great Britain to regulate the level of the Lake of the Woods. The convention was concluded in Feb. 1925, and provided, among other things, that a flowage easement would be permitted up to 1,064 ft. above mean sea level upon all lands bordering upon the Lake of the Woods in the United States, and that the United States should provide such protective works and measures in the United States along the shores of the Lake of the Woods as might be necessary for the protection of property rights and interests of the inhabitants of the territory affected. The convention also provided that, in consideration of the work to be done by the United States, the Government of Canada shall pay the Government of the United States the sum of $275,000. An Act of Congress approved May 22, 1926, directed the Secretary of War to carry into effect the provisions of this convention. The Secretary states that the Engineer Department of the Army has done considerable work of an engineering nature in the region of the Lake of the Woods. The Lake Survey work was extended in 1914 to include the Lake of the Woods and other boundary and connecting waters between this lake and Lake Superior. The District Engineer at Duluth, Minnesota, has done considerable work in the boundary waters in his capacity as American Engineer to the International Joint Commission, and can supply the organization and equipment to do the work required by the provisions of the convention.

H. W. L. Gardiner, McGraw-Hill Business Manager, Dies

H. W. L. Gardiner, business manager of McGraw-Hill publications on the Pacific Coast, died on June 25. Mr. Gardiner in 1917 gave up his own advertising agency in Los Angeles, which had been very successful, to take charge of advertising in the Pacific Coast territory for the McGraw-Hill Publishing Co., at that time publishing seven journals. He rapidly built up the advertising department on the West Coast and as the company acquired new papers, took on responsibility for the additional accounts that were thus added to the list. In recent years, together with H. C. Worden, Mr. Gardiner effectively handled the Western advertising accounts for all fifteen McGraw-Hill publications, making his headquarters at San Francisco. In the course of frequent trips over Coast and Mountain states during this eight-year period he made friends very extensively and his passing will be felt as a loss throughout the West. Mr. Gardiner's death came unexpectedly and while he was in excellent health except for somewhat impaired eyesight. An operation for this eye trouble developed complications and his death occurred only a few days later.

Commissions to Confer on St. Lawrence Power

New York Commission to Meet with Ontario Body and Federal Power Commission

The New York State Water Power Commission on June 29 approved in principle the report and recommendations of the State Engineer, abstracted in our issue of July 1, p. 29, on the St. Lawrence River power situation. In executive session it was decided to confer through a committee with authorities of the province of Ontario with a view of discussing with them matters which would be involved.

Negotiations will also be had with the Federal government and other agencies whose permission is necessary before development can be had to ascertain their views regarding terms and conditions of a lease. The matter will also be taken up with the two applicants, the American Super Power Corporation, and the Frontier Corporation whose applications are now pending before the commission. W. R. Thompson, engineer of the American Super Power Corporation was the only appearance at the meeting representing either of the applicants.

PROVISIONS OF LEASE

The report of the State Engineer suggests the following provisions be written into any lease:

1. The license period not to exceed fifty years and a definite term of no more than three years within which the licensee to proceed must obtain consents from other governmental agencies. Failure to obtain consents within that time would exact a renewal of the license by the state.

2. The license fee to be payable on completion of project but not later than five years from the date when full authority to begin construction is granted.

3. Inspection by the state during construction to make certain that the project is built in accordance with the conditions of the license and to make ascertainable the actual cost. The expense of such action of the state to be paid by the licensee.

4. The licensee to post a faithful performance bond of $10,000,000 to carry out construction in accordance with the terms of the license.

5. On the final completion of the project the state reserves the right to purchase at cost plus fifteen per cent or at any time during the license period of five years notice at cost, less amount set aside for amortization, plus fifteen per cent.

6. Guarantee that transmission lines will be provided by the licensee to insure distribution of St. Lawrence current in every section of the State of New York.

7. Full authority by the Public Service Commission to fix rates at which current is sold, muncipalities to be given preference.

8. The license fee to be adjusted at the end of five years and thereafter at ten year periods.

9. At the end of fifty years, if the state has not taken over the project, all property, dams, power houses, machinery, lands and riparian rights on this side of the international boundary revert to the people without cost or expense, a quit claim deed to be immediately executed and filed to carry this into effect.

"Considering the license fee that would be paid into the state treasury for the privilege of making this development, the taxes to be paid to the state, county and locality on taxable property created by the development and the equity which the people gain each year in ownership, would aggregate a return of substantially $5,000,000 a year.

"The desirability of developing our natural resources precludes controversy, the course to pursue being the adoption without further delay of a practical development of the St. Lawrence and in so doing preserve for the people their inalienable rights of ownership and control," the report concludes.

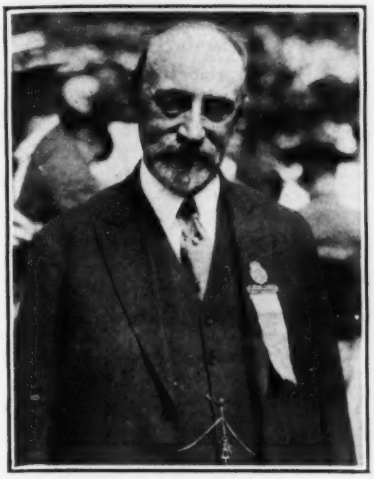
It is stated that it will be several weeks before the commission will be in position to take definite action on the pending applications.

New Contract Let for Disposal of Passaic Valley Sludge

The contract for disposing of the sludge from the sewage works of the Passaic Valley Sewerage District, on the Newark Meadows, by towing and dumping at sea during the period from July 15, 1926, to July 15, 1927, was awarded on June 22 to Joseph F. O'Boyle at 34c. per ton, assuming 1 cu.yd. of sludge as the equivalent of 0.86 tons regardless of moisture content. Another bid was 33.9c. per ton, by Edward J. Branigan, from whom and a brother the commission took over an earlier contract for sludge disposal by sea dumping a year ago. The price under the earlier contract was not a per ton basis, but was for furnishing continuous service of one barge of the capacity from 1,000 to 1,500 tons for a period of 9 months at $3,000 per month. A separate contract provided for furnishing towing service and this contract was performed by the Moran Towing & Transportation Co. for $265 per round trip. This arrangement did not work out satisfactorily and the present arrangement of having the work done on a per ton basis, the price including both barge and towing service was entered into a year ago, when the Joseph F. O'Boyle Co. was low bidder, at 37c. per ton. That contract expires July 15 of this year and a new contract has been entered into with the O'Boyle Co. for another year's duration, the contract price being as aforementioned 34c. per net ton including both the towing and barge service.

Rivers and Harbors Bill Held Over Until December

The House Rivers and Harbors bill was not acted upon by the U. S. Senate before adjournment. Under an "unanimous consent agreement" the bill will not be taken up until Dec. 14 with debate limited to Dec. 20.



RALPH MODJESKI

Ralph Modjeski, chief engineer of the Philadelphia - Camden bridge, on the day of the opening of the bridge. Mr. Modjeski has been an outstanding figure in bridge design and construction for many years.

WASHINGTON NOTES

RIGHT-OF-WAY on public lands has been granted, in a law recently approved, to irrigation ditches and other related works but location is subject to the approval of the Secretary of the Interior.

AS A result of questions raised by the Federal Power Commission the Chief of Engineers is having a further study made of the New and Kanawha Rivers in West Virginia to determine if impulses caused by the release of water from the proposed reservoir on New River of the New River Power Co. will affect navigation on the Kanawha.

Gage readings indicate that the power waves from the Ivanhoe plant of the Appalachian Power Co. do not reach the Kanawha, but it is contended that the type of gage used will not give an accurate indication of variation in discharge, which affects the quantity of water without affecting the depth. Further checks are being made. An interesting feature of this investigation is the great scarcity of data on a matter as important as power waves, which, on the Pit River, persist throughout the length of the stream and for 120 miles down the Sacramento.

ADDITIONAL data with regard to the use of water along the lower Rio Grande must be obtained before the Commission on the Equitable Use of the Waters of the Lower Rio Grande can proceed with its work. The Commission, which is composed of Dr. Elwood Mead, the Commissioner of Reclamation, Major General Lansing H. Beach, former Chief of Engineers, and W. E. Anderson, of San Benito, Texas, concluded several days sessions in Washington on June 19.

The discussion of the situation revealed the need of fundamental data and Mr. Anderson was commissioned to superintend its collection. The necessary technical personnel will be furnished by the Reclamation Bureau. The Mexican members of the commission have not been named, but it is understood that Senor Gustavo Serrano, the chairman of the International Boundary Commission, is to serve as chairman of the Mexican Rio Grande Commission. It is expected that the first meeting of the full commission will be held this fall.

THE Federal Power Commission on June 23 authorized a license for the East Bay Municipal Utility District of Oakland, California, covering the project on the Mokelumne River. The project is to consist principally of the Lancha dam and reservoir which is to be constructed primarily as a source of municipal water supply. Power is to be developed as a byproduct. The conflicting application of Stephen E. Kieffer was rejected.

The license issued to the Columbia Valley Power Co. covering the Pelton and Metolius sites on the Columbia River has been extended for two years. This is done to allow more time in which to develop the market.

Dam No. 10 on the Kentucky River has been included in the preliminary permit of the Kentucky Hydro-electric Co. The permit issued that company on January 28, 1926, covered the United States dams on the river from No. 8 to No. 14, inclusive, with the exception of Dam No. 10, for which a preliminary permit previously had been issued to the Winchester Water Works Co. The latter permit expired March 4, and the Water Works company advised that it did not desire to proceed further with its proposed project.

LONGEST SUSPENSION BRIDGE OPENED TO TRAFFIC

On July 1 the world's longest suspension bridge, that over the Delaware River between Philadelphia, Pa., and Camden, N. J., was formally opened to traffic. The main span between centers of towers has a length of 1,750 ft., or 118 ft. longer than the main span of the Bear Mountain bridge, which, for a brief period of about two years, held the record as the longest suspension span. The bridge has a total length of 1.8 miles and a clearance of 135 ft. above river level at the center of the main span. Construction was begun on Jan. 6, 1922. Some minor details of construction remained to be completed when the bridge was opened.

The picture shows the people swarming over the roadway deck on July 1, following the ceremonies of opening the bridge. The roadway is 57 ft. wide between curbs, designed for six lanes of traffic, and the entire deck is 125 ft. 6 in. wide, provision being made for four lines of rapid transit railway, one on each side of each truss. The footwalks are outside of the upper chord of the trusses above the outer rapid transit track.

RANDOM LINES

And Still They Come

Sir—Here is another "Engineer" for your list in Random Lines, a Record Protection Engineer, who turns out to be a salesman for safes. I. R. S.

* * *

A Galled Jade Winces

Sir—In your May 27 column you complain about the use of "stadia" as the plural of "stadium." You say the word "stadia" has another and (to engineers) a better-known meaning. Don't you know that the well-known English language includes thousands of words that have two or more wholly different meanings? For example—

Spring: A season of the year, a flow of water from the earth, or the thing that busts when you drive over the bumps too fast.

Sanguine: A hopeful state of mind or a blood-red color used by artists; and *sanguinary* means bloody murder!

Steer: An incapacitated male cow, a hunch, or a verb denoting direction of one's course.

Engineer: According to "Random Lines" this word has 176 different meanings, with new ones coming in every week. BOWGIE.

Sure! We know all that, but does that justify us in going out of our way to create, from a very dead language, a new and duplicative word when our own language has a perfectly good, and unique, word for the occasion. Because our forefathers lacked ingenuity, shall we continue to clutter up the common tongue.

* * *

The Inspector

By Elldee

All day he tramps about the job puff-puffing on his old corn cob, inspecting this — inspecting that, his tattered, weather-kissed felt hat pulled down to shield his eagle eye from Old Sol's hot shafts from on high—which otherwise might pull his cork and dry him up like old New York. He sees all—knows all —keeps things straight. He is a tried and trusty skate, who measures to a tinker's yam the "mix" that goes into the dam; who keeps retaining walls to line—not crooked as a pumpkin vine; who sees that cuts and fills are made at right degree of centigrade. From dawn till dark, day out, day in, from concrete shack to gravel bin, from dizzy slope to deepest ditch, with nerves attuned to keenest pitch, he "carries on," and when night falls and off he peels his overalls and flops back in the fragrant hay to saw wood till another day, he sleeps the slumber of the blest, for he has done his level best to make the "big dream" come to pass—and earn his little bag of brass! A good inspector on the job with pep and something in his knob, who sails right in and does his work and has no time to loaf or shirk, will "get there" in due course of time and he won't have to scribble rhyme; for many "big chiefs" of today at one time drew inspectors' pay!

Mechanical Engineers Discuss Hydraulic Problems

The American Society of Mechanical Engineers held the spring meeting at San Francisco, June 28 to July 1. Among the subjects discussed were three papers presented in the hydraulic session which were of special interest to civil engineers. These were: "Aspect of Steam Power in Relation to a Hydro Supply" by A. H. Markwart, vice-president in charge of engineering, Pacific Gas & Electric Co.; "Water Power and Steam Power in California Utilities" by H. A. Barre, executive engineer, Southern California Edison Co.; and "Speed Changes of Hydraulic Turbines for Sudden Changes of Load" by Earl B. Stowger, Niagara Falls Power Co., and S. Logan Kerr, Jr., assistant hydraulic engineer, William Cramp & Sons Ship & Engine Building Co., Philadelphia. All these subjects were discussed from the floor. A feature of the meeting was the presence of seven past presidents of the Society.

San Francisco Studying Garbage Disposal Proposals

Six proposals, mostly vague and tentative, for disposing of the garbage of San Francisco or for selling incinerators to the city, were referred to the health committee of the Board of Supervisors on June 14. George W. Beers offered to convey the garbage 30 miles out to sea and dump it there during a period of five years for 80c. a ton. The Decorie Incinerator Corporation offered to build incinerators of 800 tons-per-day capacity for $1,300,000. A. H. Hyde expressed willingness to submit a bid for sea dumping. The Scavengers' Protective Union which disposes of the garbage collected by its members, putting a part of it through an old Thackeray incinerator owned by the city, offered to build a new incinerator on the Thackeray site if awarded a 25-year contract. The Ludwig Garbage Incinerator Co. proposed to build incinerators, and operate them for 25 years. All these proposals were received June 14. An earlier proposal, also referred to the health committee, was by F. W. Camp, who offered to cover the garbage with earth and rock being placed under a contract for making an extensive fill on the shore of San Francisco Bay in the south part of the city.

Would Have Detroit Water Board Build City Hall

A plan to have the water board of Detroit, Mich., finance and build a new city hall has been announced by John W. Smith, mayor. The board now owns and uses a separate building. The sale of this and other city property would pay a considerable part of the cost of the proposed city hall. If the water board built the city hall, the mayor states, the bonds needed to finance it could be issued outside the debt limit. An earlier proposal for a joint city and county building has been abandoned on account of unforeseen complications.

Rhode Island State Supreme Court Upholds City Zoning

The constitutionality of municipal zoning in Rhode Island, in so far as the case at bar is concerned, has been upheld by a decision of the State Supreme Court in a suit attacking the validity of a Providence zoning ordinance. The case has not yet been heard upon its merits having been certified from the Superior Court on the question of whether the zoning statute of the legislature (Chap. 57, Gen. Laws R. I., 1923, as amended by Sec. 1, Chap. 430, Rev. Pub. Laws R. I., 1923) was a violation of Art. XIV, of the Federal Constitution or of Sec. 10 and 16, Art. I of the Rhode Island Constitution.

The suit was brought as a test case by Anthony Stephens and others as to the reasonableness and validity of that part of the Providence zoning ordinance which it was alleged that Stephens was violating in permitting occupancy by five families of a building erected under a permit for a two-family house, in a section zoned as a dwelling-house district.

After stating that its decision had been made "not without some hesitation" the Supreme Court said in part: "Zoning legislation is one of the latest examples of the interference with private rights upon the claim of a promotion of what is rather indefinitely termed the general welfare. . . . In view of the broad power given to cities in our enabling act to establish so-called use districts and in view of the provisions common to zoning regulations authorized in other jurisdictions we think it may be said fairly that it was the intent of the General Assembly to authorize the establishment of residential districts in which only dwellings for one or two families should be permitted and from which apartment houses should be excluded. The matter before us distinctly presents the question whether, in authorizing such a classification of and restriction upon the use of land for residential purposes the General Assembly has gone beyond the bounds of a reasonable exercise of the police power. The propriety of such a classification of residential districts is not as clear to us as is that of the exclusion of trade and industry from the sections devoted to residence." The case was referred back to the lower court for trial on its merits as to reasonableness.

Track Completely Laid on Two New Railway Lines

Laying of the main track on the Natron cut-off of the Southern Pacific Company between Kirk and Oakridge, in Oregon, was completed on June 14, and it is expected that the new line will be ready for the operation of trains about the middle of August. Three days later the last main line rails of the Southern Pacific's new main line in Arizona were laid, the last rail being placed on the bridge over the Gila River. It is expected that this line will be opened for regular passenger traffic in the early fall.

Navigation Congress to Meet at Cairo, Egypt

The fourteenth International Navigation Congress is to be held at Cairo, Egypt, in November-December next. Final dates have not yet been announced.

Agricultural Engineers Meet at Lake Tahoe

The American Society of Agricultural Engineers held their twentieth annual meeting at Lake Tahoe, Calif., June 23 to 26, inclusive. The subjects discussed included farm structures, rural electrification, farm machinery, soil surveys, drainage, and subjects comprised within the scope of agricultural engineering generally. Particular attention was given to the sessions on rural electrification and at the general session, Dr. Elwood Mead read a paper on "A National Reclamation Policy—What It Should Include."

Change in New Railway Line in Florida Approved

A change in the alignment of the railway which the Atlantic Coast Line Railway Co. is building in Hillsborough and Pasco Counties, Fla., has been authorized by the Interstate Commerce Commission. The railway company orginally asked authority to build a line from a connection with one of its branch lines near Thonotosassa in a northeasterly direction to Dade City, approximately 21 miles. This project was approved March 11, 1926. Now the railway company has applied for permission to change the alignment so that the new railway will pass through Zephyrhills and strike the company's West Coast main line about 7 miles south of Dade City at Richland, continuing along the right-of-way to Dade City, a distance of 22½ miles. Work is to be commenced by Sept. 1 and completed before the end of 1927.

Hudson River Dredging to Start

The first contract for dredging work for the "Deeper Hudson," under Federal appropriation, will be let within a month.

That portion of the Hudson River between Van Wie's Point, four miles south of Albany and the Castleton bridge was selected at a conference of government engineers at New York City held on June 21 as the site where the initial dredging will begin, according to an announcement by John D. Myton, engineer in charge of the Albany office. Engineers in the Albany office are drawing plans and specifications for dredging the 27 foot channel to Albany in the Hudson River.

If all present plans are carried out without hitch, engineers should be able to let the first two dredging contracts before the end of July. The first two contracts are to be financed by an initial $800,000 appropriation which became available July 1.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, N. Y.; Summer Meeting, Seattle, Wash., July 14-16; Annual Convention, Philadelphia, Pa., October 4-9, 1926.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Meeting, Providence, R. I., Sept. 14-17, 1926.

INTERNATIONAL CITY MANAGERS' ASSOCIATION, Lawrence, Kansas; Annual Convention, Colorado Springs, Colo., Sept. 21-23, 1926.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.; Annual Convention, Pinehurst,, N. C., Nov. 8-12, 1926.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Louis, Mo.; Annual Meeting, Washington, D. C., Nov. 8-12, 1926.

THE ASPHALT ASSOCIATION, New York City; Annual Meeting, Washington, D. C., Nov. 8-12, 1926.

The Ohio Water-Works Association held its annual meeting July 1 and 2 in Columbus. George Whysall, general manager of the Marion water-works, spoke on "Meters and Their Testing." C. B. Hoover, superintendent of the Columbus water-works department, described the city's system of purification and direct pumping into the mains. T. D. Pierce, engineer of the Ohio Public Utilities Commission, discussed "Valuation and Rate Making of Utilities." Election of officers resulted in the re-election of W. H. Sharp, Columbus, as president; S. R. Case, Bowling Green, vice-president and W. H. Miller, Columbus, secretary-treasurer.

Saginaw Engineers' Club, Saginaw, Mich., was organized June 29 with the following directors: G. W. Francis, Francis Engineering Co.; E. A. Kreuger, Saginaw Transit Co.; Z. E. Colby, Baker-Perkins; H. D. Tubbs, Pere Marquette Ry.; E. H. Spencer, Saginaw County Deputy Drain Commissioner.

The American Electrochemical Society plans a symposium on "materials for use under extreme conditions" for the Washington meeting of the society, Oct. 7 to 9. Dr. H. W. Gillett, Bureau of Standards, is chairman of the symposium. The problem of developing materials for special service is regarded as largely an electrochemical problem, since the art produces such materials as tungsten, chromium and vanadium.

Personal Notes

SIR HENRY THORNTON, president of the Canadian National Railways, received from Syracuse University June 15 the degree of doctor of engineering.

W. J. JAMIESON has been appointed city engineer and superintendent of streets at Phoenix, Arizona. HENRY RIEGER has been city engineer and was also elected city manager and for some months carried both offices; he has now resigned the post of city engineer and Mr. Jamieson takes this work.

RAYMOND FINK, who has been vice-president of Pierce, Butler and Pierce, Boston, Mass., has joined the executive staff of The Sherman Corporation, Engineers.

T. P. PENDLETON has joined the organization of Brock & Weymouth, Inc., of Philadelphia, to have charge of plant production of aero-topographic maps, leaving the position of chief, Section of Photographic Mapping, U. S. Geological Survey.

THE WALTER BATES STEEL CORPORATION, Gary, Ind., announces that the following three men are now associated with them. C. L. WALKER, formerly assistant manager of the American Bridge Co.'s Gary plant is now manager; JAMES S. MARTIN, formerly structural and transmission line engineer with the Duquesne Light Co. at Pittsburgh, is chief structural engineer; and E. L. GEMMILL, formerly chief structural engineer of the Blaw-Knox Co. at Pittsburgh, is sales manager of the tower division.

A. R. RAYMER has been appointed assistant vice-president of the Pittsburgh & Lake Erie R.R. and the Lake Erie & Eastern R.R., with office in Pittsburgh, Pa.; he also will continue to act as chief engineer.

L. R. BROWN, city engineer of Sault Ste. Marie, Ontario, has accepted a position at Cornerbrook, Newfoundland, as technical engineer with the Newfoundland Power and Paper Co. Mr. Brown was city engineer at the Soo for five years.

HOWARD J. WILLIAMS, formerly assistant engineer on the design of the new Scituate reservoir for water supply for the city of Providence, R. I., has joined the staff of Fay, Spofford and Thorndike, consulting engineers, Boston, Mass.

J. S. WILSON, for the past three years superintendent of dredging operations and later superintendent of mechanical equipment, for the United States engineer office at Wilson Dam, has resigned to become vice-president and general manager of the Tennessee Valley Sand & Gravel Co., at Sheffield, Ala.

Obituary

HENRI PAUL LEFEBVRE, a prominent civil engineer of Montreal, died at his home in that city on June 23 following a long illness. He was 71 years of age, and was born in Paris, France, where he graduated from the Ecole Centrale. Mr. Lefebvre was a member of the Engineering Institute of Canada and the Société des Ingénieurs Civiles de France.

Construction Equipment and Materials

A SECTION DEVOTED TO WHAT THE MANUFACTURER IS DOING FOR THE ENGINEER AND CONTRACTOR

Growing Field for Pumps at Grade Crossing Separations

With the increasing necessity and use of grade crossing separations in which the highway is depressed, a field for automatic pumping stations is being opened. Seven of these stations were recently installed jointly by the Detroit, Toledo and Ironton R.R. and Wayne County, Michigan, for the collection and disposal of the storm water.

Concrete pump houses were erected containing electrically driven pumps operated from local power lines. Concrete sumps sunk about 15 feet below the pavement collect the water from catch basins located at intervals along the line of the depressed highways, the water being diverted underground through vitrified tile drains. Other catch basins above the pump house floors, but below railroad grades, provide receptacles for the water as it is pumped from the sump; these catch basins are sufficiently elevated to allow a gravity flow through vitrified pipe into drainage ditches under the tracks. On these installations American Well Works pumps are used at six of the crossings and all the pump houses are equipped with General Electric motor drive with automatic control. A typical installation consists of two 8-inch centrifugal pumps erected over a 17,800 gallon sump. Each pump has a capacity of approximately 860 g.p.m. and is driven by a 10-hp. motor having a double squirrel cage rotor. Float switches in the wells control the pumping motors through magnetic switches. The pumps supplement each other, one or both being thrown into action as the level of the water rises.

Dredge Manufacture on a New Basis

Dredges in use at the present time are assemblies of the fabricating parts made by several manufacturers. They have been purchased from a manufacturer who furnishes either the dipper, the power unit or the hull, and who contracts with other specialists to furnish that part of the dredge which he is unable himself to manufacture.

The American Brown-Boveri Electric Corp., New York City, believing economy, speed in delivery and more efficient equipment can be furnished in a machine built completely at one plant and under one responsibility, has formed a new department to design and build dredges in their entirety. Since it is felt that dredge manufacture is primarily a naval architect's job, the company feels especially well equipped since it has organized the large plant and ways formerly owned by the New York Shipbuilding Corp. at Camden, N. J., to give this specialized service. The designs and manufacturing rights of A. W. Robinson, a specialist in dredge design, have been acquired and Lieut. R. W. Berdeau, associated for many years with the dredging division of the U. S. Engineers during the construction of the Panama Canal has been placed in charge of the department.

Dredges, as a rule, must be built under special plans, but many are susceptible to standardized designs. Deviations of course will be made from these standards as required by the purchaser's special operating problem, but where standardized sizes can be used the company recommends 5, 7½ and 10 cu.yd. for dipper dredges and 16, 20, 24 and 30 inch sizes for suction dredges.

In addition, the Dredge and Harbor Department is prepared to furnish smaller craft and harbor improvement units such as drill boats, car floats, barges, scows, floating cranes, floating pile drivers, pipe line pontoons, tugs and ferries.

Employee Magazines

A report by the Policyholders' Service Bureau of the Metropolitan Life Insurance Co., New York City, on employee magazines, suggests that one of the main reasons for the existence of employee magazines is that they give the workers a chance to express themselves and encourage thinking; also that they develop understanding between management and employees and give both a chance to see the other one's side.

At the same time just how to edit the magazine, its contents, layout and distribution are recognized as a most delicate problem. The material given in the report which is numbered 74 is practical and was taken from the best practices used by group insurance policy holders of the Metropolitan who issue employee magazines. Combinations of plant and public papers are not considered nor is any space given to advertising mediums.

Business Notes

THEW SHOVEL CO., Lorain, Ohio, has recently opened new district offices in Atlanta, Ga., with D. G. Savage in charge. Another new office has been opened in the General Motors Building, Detroit, with H. W. Miller in charge.

CHAIN BELT CO., Milwaukee, announces that Charles E. Stone, for several years assistant to the president, has been elected vice-president and general manager of the Interstate Drop Forge Co., Milwaukee, manufacturers of commercial drop forgings. C. C. Bremer, for a number of years comptroller for the Interstate Drop Forge Co., was elected secretary.

R. H. BAKER CO., INC., Cambridge, Mass., has secured the services of H. N. Carlson as engineer of construction and design.

JAMES MCNEIL & BRO. CO., Pittsburgh, manufacturers of steel plate products and riveted steel pipe, announces the following changes in its personnel: Arthur Huehn has been elected general manager in place of C. V. Witt, resigned; A. E. Anderson has been elected treasurer and H. K. Stevenson has been elected secretary, in place of N. G. Beale, deceased. The new officers are all men of long service with the company.

B. M. HORTER, formerly of the Philadelphia office of the Cutler-Hammer Mfg. Co., has just been appointed manager of the company's Boston office. He succeeds J. M. Fernald who has resigned.

READING IRON CO. announces that H. E. Vickerman, formerly with the Oil Well Supply Co., has joined its sales force and will sell the company's wrought iron pipe in California. His headquarters are at 826 Van Nuys Bldg., Los Angeles.

New Developments

Educational Film on Steel Pipe Manufacture

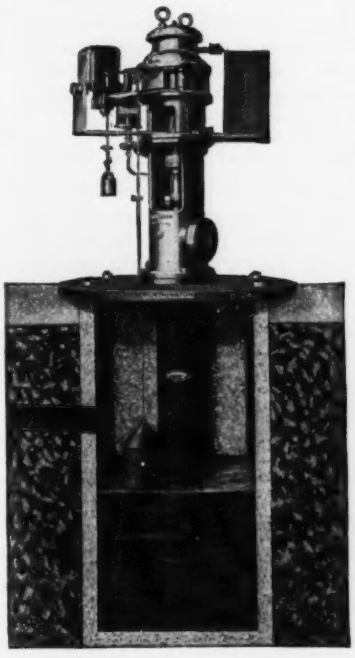
(The following item is published as a correction for a similar one appearing on p. 1004 of the June 17 issue of "Engineering News-Record." In this item the pipe was referred to as wrought iron. The National Tube Co. does not manufacture wrought-iron pipe in any form.)

The National Tube Co., Frick Building, Pittsburgh, Pa., has had prepared a second educational motion picture showing its methods of manufacturing steel pipe. The new film, known as "The Arteries of Industry," gives an intelligent conception of the manufacture of steel pipe by showing the series of operations in the mill and animated diagrams of some of the important processes. The first film, which has been out for some time, was of the same general nature and entitled "From Ore to National Pipe." These films are loaned without charge by the National Tube Co.

New Sump Pump for Building Installation

A sump pump has recently been placed on the market by the Worthington Pump & Machinery Corporation, New York City, for the drainage of sumps located in cellars of buildings below the sewer level. The pump operates on the same general principle as the Worthington deep well pump. A special feature is the absence of complicated piping.

The pump consists essentially of a driving head supporting a drop pipe within which is a shaft containing one or more open type impellers and guide vanes. The drop pipe in addition to supporting the impeller section of the pump, serves to conduct the water to the top, thus eliminating the necessity of using the usual separate discharge pipe. The impellers are of such shape



as to give practically an axial flow of water, hence the name Axiflo. On top of the driving head is mounted a vertical motor, the thrust bearing of which carries the pump thrust load. The motor is automatically controlled by means of a float switch. The pumps are made with one to four stages for all pump service capacities and head requirements.

Locomotive for Gaseous Tunnels

Approval has recently been granted by the Bureau of Mines to the General Electric Co. covering a permissible-storage battery locomotive for use in gaseous tunnels and mines. The locomotive has a rated weight of 6 tons and is of the outside frame construction, having the weight of the locomotive supported from the journal boxes on heavy semi-elliptical springs. The motors are of the box frame type, spring suspended from the locomotive frame, and drive the axles through single reduction spur gearing.

The control equipment consists of a master controller, contactor group, protective relays, and a resistor. The use of this type of control is particularly advantageous since it operates reliably with a minimum of inspection. This is a important factor with totally inclosed equipment.

Hoisting Unit for Attachment to Fordson Tractor

A general purpose hoist for attachment to the Fordson tractor is a development of the Ersted Machinery Mfg. Co., Portland, Ore. The "Hyster," as this hoist is known, is supplied in either single or double-drum models and is driven by means of a roller chain from the Fordson power take-off. Attachment to the Fordson is through steel channels bolted to the tractor frame. The regular uses of the tractor are not interfered with. Accessories are available that enable the hoist to be used for applications such as material elevating, general derrick work, pipe laying and trench back-filling.

Mechanical Bricklaying as Used in Scotland

Developed in connection with a large housing scheme in Glasgow, Scotland, a mechanical bricklaying machine has now been placed on a commercial basis by Sir William Arrol & Co., Ltd., of Glasgow. It is not intended that the machine should be used on any but large housing schemes of about 100 houses or more.

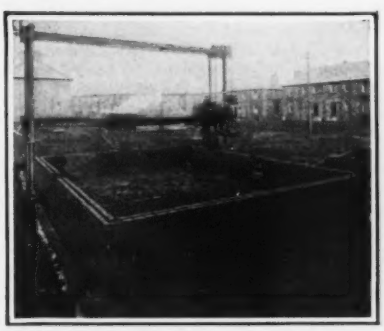
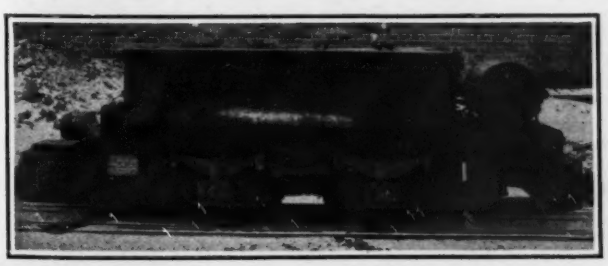


FIG. 1—AUTOMATIC BRICKLAYING TRAVELER USED IN SCOTLAND

It is known as the "K" erector and consists of two tubular uprights spanned by a beam at the top below which is a movable boom carrying the bricklaying carriage. The equipment is in the form of a traveler operating on a rack track. The boom is raised and lowered by means of wire ropes. While laying bricks parallel to the track as shown in Fig. 1, the carriage is fixed on the boom; laying bricks across the end of the building, the carriage moves along the boom, the traveler remaining stationary.



The carriage, motor and mortar tank move together. In operation, a rotating wheel takes two bricks at a time from the hopper and a mortar measuring wheel spreads the mortar. After one course of brick is laid entirely around the structure, the boom is raised the thickness of a brick and mortar joint and the operation repeated. Automatic stoppage of the machine is possible at openings for doors and windows.

Brick and mortar are supplied to the carriage during the time it is moving

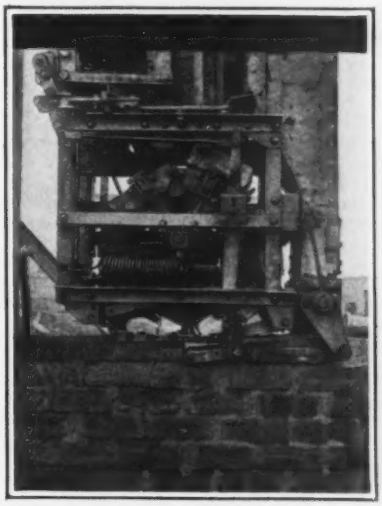


FIG. 2—AUTOMATIC BRICKLAYING CARRIAGE

across the boom. Feeding of the bricks to the hopper is preferably performed by hand. The operation of spreading the mortar is performed by means of an adjustable measuring wheel which feeds the requisite quantity to small conveyors to which are attached the spreading and buttering mechanism. The machine is now in use in Glasgow building 11-in. hollow and 4½-in. brick walls. It has been found that one man feeding the hopper will average 1,200 to 1,500 brick per hour, or about 10,000 per working day. Three men are required to work and feed the machine and the motive power is supplied by a 3-hp. motor. The approximate cost is said to be about £800 with erection and dismantling costs £10 and £5 respectively.

New Publications

Steel Cross Ties—BETHLEHEM STEEL CO., Bethlehem, Pa., has issued a new catalog describing its steel ties for mines and industrial tracks. It is known as booklet 31-A.

Concrete Block — BLYSTONE MANUFACTURING CO., Cambridge Springs, Pa., has issued two small pamphlets describing machines for making its special concrete block. The complete unit consists of a mixer, spiral conveyor, casting machine and disposal chain conveyor.

Rock-Crushing — ALLIS-CHALMERS MFG. CO., Milwaukee, Wis., in bulletin

1464, dated May, 1926, devotes 70 pages to a description of modern rock-crushing plants. After illustrating and describing its various types of crushers and crushing plant equipment, about 30 pages of line cut drawings showing crushing plants designed and equipped by the company are given.

Yellow Pine Data—SOUTHERN PINE ASSOCIATION, New Orleans, La., has issued a small booklet in which are discussed the stresses to which structural timbers may be subjected, including recommendations for the correct use of Southern yellow pine.

Public Utility Investments—H. M. BYLLESBY & Co., 231 S. La Salle St., Chicago, has published a 32 page illustrated book describing Standard Gas & Electric Co. and its operated and affiliated public utilities. Standard Gas & Electric Co. supplies electric power, light, gas, street railway, telephone and steam heating services to a total estimated population of 5,500,000 in more than 1,190 communities of nineteen states. Especially fine photographs of the principal steam and hydroelectric stations, gas manufacturing plants, substations, etc., are reproduced.

Centrifugal Pumps—DEAN HILL PUMP CO., Anderson, Ind., in Circular No. 402 describes and illustrates its double suction centrifugal pump built in sizes of 1 to 36 inches. Both the motor and turbine drive types are shown.

Diesel Engines—FOOS GAS ENGINE CO., Springfield, Ohio, has issued Bulletin No. 707 describing its type "L" Diesel engine, a new development for use on cranes, power shovels and other mobile and semi-mobile equipment. The bulletin is in the form of an announcement giving the salient features.

Concrete—NORTH AMERICAN CEMENT CORP., Hagerstown, Md., has issued a bulletin entitled, "Quick Hardening Concrete," which is described as a "practical consideration of products, methods, results and costs." It treats of the application of the company's product, Cal, to concrete mixtures as an accelerator and water-requirement reducer.

Lubrication—THE TEXAS CO., New York, N. Y., issues each month a booklet entitled "Lubrication" which is devoted to the selection and use of lubricants on the various classes of equipment. One of the recent issues was on tractor lubrication and lubricants, and in all of them much practical information is given.

Power-Shovel Transformers—WESTINGHOUSE ELEC. & MFG. CO., East Pittsburgh, Pa., has published a descriptive leaflet L.20288 on its new shovel type transformers. This describes the application, construction and distinctive features of this transformer, which is designed with leakproof bushings and tank. It is of specially sturdy construction for installations where vibration is excessive and where the transformers are subjected to inclination at various angles.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

This Week's Contracts—Week Ago—Same Week Last Year

THE money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks. Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial buildings.

Money Value of Contracts Let—Entire U. S.

Week Ending	Public Work	Private Work	Total Contracts
July 8, 1926	$36,050,000	$32,188,000	$68,238,000
July 1, 1926	23,420,000	38,845,000	62,265,000
July 9, 1925	12,346,000	7,817,000	20,163,000
Heaviest Week			
1926, Mar. 11	13,029,000	73,613,000	86,642,000
1925, Sept. 3	16,215,000	69,424,000	85,639,000
January 1 to date			
1926	571,426,000	921,558,000	1,492,984,000
1925	531,881,000	672,430,000	1,204,311,000

Increasing Quantities of Foreign Brick Entering U. S. Markets

Manufacturers Assoc. Claims Importation Constitutes Most Serious Difficulty Confronting Domestic Makers

DURING 1923, the second year of the present construction boom, foreign manufacturers awakened to the possibilities existent in the American materials market for a clay building unit conforming to standard consistency and size, that is, 8x3¾x2¼ in.

Previously, the European product had been conspicuously different from the American conception of a common brick, in that it was nearer the size of a paving block, which measures 8½x4x3-in.

As soon as samples were procured and foreign makers had adjusted their machines to the American size, Belgium, Germany and Holland began sending in considerable quantities. Smaller shipments were also received from Canada, Italy, England, Mexico and Spain. Belgium and Germany, however, remain the principal exporters of common building brick, since Holland produces largely the ornamental varieties.

The following extract is from a digest of conditions in the common brick industry, prepared by the Common Brick Manufacturers' Association of America; it gives the manufacturers side of the foreign brick question:

"Imagine a city, supported by a single basic industry, employing 113,000 people with a weekly payroll of $2,800,000, which, with the families of the wage earners, plus tradesmen and public service employees, makes a city of a million inhabitants, being wiped off the map of the U. S.

"Such a catastrophe is actually threatened in America today. If all of the clay products plants in the U. S. were consolidated into a single factory surrounded by the stores, schools, churches and amusement places and public buildings necessary for such a community, you would have just such a city as is suggested here.

"Due to the fact that the heavy clay products are on the free list and that their manufacturers have no tariff protection against cheap foreign products, this great industry is menaced to an extent that suggests its complete annihilation. With the labor in European clay plants receiving approximately one-quarter the wages paid for similar work in the U. S., the American manufacturer is confronted with a handicap he cannot overcome even by the highly efficient and labor saving methods employed here. The destruction of this industry would be far reaching and affect many other basic industries. For example:

"The clay plants in the country use every day 450 cars of coal of 60 tons each, or an annual supply of 9,740,000 tons. No less than 100 plants throughout the country are engaged today in manufacturing machinery alone for the clay products plants and great quantities of supplies and equipment of their kinds are consumed. The railroad tonnage shipped by these clay plants is approximately 34,000,000 tons, requiring 2,330 forty-ton cars daily.

(*Continued on p. 83*)

Unit Prices On Highway Materials In Place

THE following tabulation compares unit costs of surfacing and excavating, also reinforcing steel and structural concrete in place, on various highway jobs throughout the country. Average distances that materials were hauled to site of job and hourly wages paid common laborers, are also shown. These contracts have all been awarded since the first of the current year and cover eight different types of road surfacings in six states.

BID PRICES, BUREAU OF PUBLIC ROADS, U. S. DEPARTMENT OF AGRICULTURE

County	Contract Let to	Type	Thickness of Surfacing, Inches	Unit Prices Bid—Materials in Place: Surfacing Sq. Yds.	Surfacing Unit Price	Excavation Cu. Yds.	Excavation Unit Price	Structural Concrete 1-2-4 Cu. Yds.	Structural Concrete 1-2-4 Unit Price	Steel Reinforcing Lbs.	Steel Reinforcing Unit Price	Average Haul, Mi.	Average Hourly Wage, Common Labor
IDAHO													
Shoshone	J. C. Maguire, Idaho Falls, Ida.	Bit. Conc.	4	64,089	$1.58	.....	.....	.....	.....	.....	.....	2.6	$0.50
INDIANA													
Lake	Reith Riley Const. Co., Goshen, Ind.	Reinf. Conc.	7	14,883	1.43	4,895	$0.65	.....	.....	46,881	$0.05	.5	.40
KANSAS													
Marion	Yancey Const. Co., Abeline, Kans.	.....	....	.....	.....	390	1.00	....	.....	30,412	.05		
						10	4.00*	345	$16.50	88,971†	.064	1	.37½
Johnson	Cook & Stucker Ottawa, Kans.	Brick	8½	65,392	3.35	45,053	.55						
						1,569	2.25*	541	21.00	50,149	.055	2	.40
Wyandotte	Davidson Const. Co. Kansas City, Mo.	Concrete	....	73,641	2.41	120,885	.43						
						4,901	1.35*	463	17.00	30,307	.05	3	.40
MASSACHUSETTS													
Berkshire	Lane Const. Corp., Meriden, Conn.	R. C. C.	8	63,986	2.19	24,500	1.10						
						2,015	2.00*	60	30.00	607,000	.04	2½	.55
GEORGIA													
Troup	J. B. McCreary Co., Atlanta, Ga.	Concrete	9	62,760	1.98	23,000	.36	47	20.00	3,200	.06	3	.20
Bryan	Gibson Const. Co., Savannah, Ga.	Gravel	6	729	4.75	40,819	.45	....	.....	.....	.....	1	.20
Hart	Campbell Const., Co., Columbus, Ga.	Concrete	9	51,031	2.14	13,730	.40						
						220	1.25*	78	25.00	5,681	.06½	1	.20
Telfair, Jeff Davis	Hardaway Const. Co., Columbus, Ga.	Surf. Tr.	1½	29,833	.66	.....	.....	.....	.....	.....	.....	½	.20
Jefferson	J. R. & J. B. Miller, Baconton, Ga.	Concrete	9	139,039	2.10	26,250	.30	....	.....	.....	.....	3½	.20
Madison	W. C. McCoy, Lafayette, Ala.	T. Soil	7	13,394	.....	32,722	.28	....	.....	.....	.....	6	.20
Emanuel	J. R. & J. B. Miller, Baconton, Ga.	Sand Clay	7	213	.45	46,085	.32	.....	.....	22,736	.05½	2	.20
Habersham	M. R. Woodall Co., Atlanta, Ga.	Sand Clay	7	6,300	.48	.....	.....	100	20.00	7,283	.05	1	.20
Toombs-Appling	Hardaway Const. Co., Columbus, Ga.	Bridge	....	8,631	1.25	.....	.....	771	39.00	4,295	.06	12	.20
IOWA													
Carroll	Daufenbach, Bacon, Duffy, Mankato, Minn.	Earth	....	.....	.....	19,478	.23	....	.....	.....	.....	...	.35
		Culverts	....	.....	.....	105,896	.35	....	.....	.....	.....	...	.35
Wayne	J. C. Parquette, De Moines, Iowa	.....	....	.....	.....	218,808	.27	....	.....	.....	.....	....	.35
Appanoose	Ryan Bros., Mo. Valley, Ia.	.....	....	.....	.....	76,950	.28	....	.....	.....	.....	...	.35
Monroe	Neighlan Bros., Omaha, Neb.	.....	....	.....	.....	160,978	.21	....	.....	.....	.....	...	.35

* Rock excavation. † Structural steel.

Increasing Quantities of Foreign Brick Entering U. S. Markets

(*Continued from p. 82*)

"The first importations of Belgian brick were in 1923 when about 2½ million common brick were received. In 1924 the quantity had grown to more than 18,000,000, and in 1925 it was approximately 50,000,000. If this ratio of increase of foreign brick is maintained, it is a matter of a few years until the importations will have completely displaced the American product. The building public is not the benefiter, but the American clay plant employees, although depending upon it, are the losers. The foreign brick is sold at only a point below the price of the American brick, the importers naturally demanding as high a price as they can get and sell it just under the lowest possible price at which the American manufacturer can sell for. The importation of these large quantities of brick has not lowered construction costs in America, nor reduced rents. All the benefits are accruing to the foreign manufacturer and his selling agents.

"The importation of brick constitutes the most serious difficulty confronting the American brick manufacturer at the present time. Since 80 per cent of the brick consumed in the U. S. is within the territory accessible to ocean going ships, the menace becomes a real one. In this connection it is important to know that existing clay plants in America are capable of producing, without a dollar of added investment in equipment, twice the quantity of brick consumed today. It is important also to consider that of every dollar paid by the consumer for brick 50c. goes to the labor which produced it, and an amount of money equal to the total expenditure for brick goes to the mechanic who places it in the wall.

"Only the seaboard plants up to this time have been seriously affected and the general condition throughout the industry continues to be prosperous."

A ruling of the U. S. Treasury Department issued in June, compels the marking of all foreign brick with the name of the country of origin. The average wage in European brickyards is about $1.15 per day.

This Week's Special Tabulation of Unit Prices

8. Brick Masonry

The following unit prices on brick masonry are included in the low bidders' estimates on various subway jobs, 1922 to date:

Location	Date	Cu. Yd.	Price per Cu. Yd.
Flushing, N. Y.	Oct. 1922	10	$34.00
Brooklyn, N. Y., Fourth Ave.	Dec. 1922	225	30.00
New York, N. Y., Sec. 2, R. 45	May 1923	150	34.00
Rochester, N. Y.	May 1923	100	25.00
Brooklyn, N. Y., Sect. 3, R. 11-B	Oct. 1923	225	25.00
Brooklyn, N. Y., Sect. 6-C, R. 8	Oct. 1924	100	33.00
Philadelphia, Pa., Broad St.	Oct. 1924	1,000	50.00
New York, N. Y., Sect. 3-A, R. 78	Jan. 1925	500	35.00
New York, N. Y., Sect. 2, R. 78	June 1925	120	30.00
Sect. 6, R. 78	July 1925	500	40.00
Philadelphia, Pa., Broad St.	Aug. 1925	150	65.00
New York, N. Y., Sect. 4, R. 102	Oct. 1925	150	40.00
New York, N. Y., Sect. 3, R. 102	Dec. 1925	150	45.00
Sect. 2, R. 102	Dec. 1925	200	35.00
New York, N. Y., Sect. 5, R. 102	Mar. 1926	100	35.00

Weekly Construction Market

HIGHER wage rates in the skilled building trades, effective May 1 to July 1, inclusive, have brought the level of construction cost to a point above that of 1925, during the period just mentioned.

Prices of materials alone, however, have followed a steady downward trend since the first of the year. Present construction cost, labor plus materials, is higher than at any time since April, 1925.

Steadiness characterizes the current market for basic materials, while labor rates will probably not go much higher between now and Dec. 31, 1926.

Five out of seven cities report no change in pine lumber quotations during the past week. Telegraphic reports to *E. N.-R.* from the northwest fir producing districts, indicate that the usual July 4 shut-down of logging camps will average one month, while saw mills will be closed for about two weeks, owing to overproduction; the labor released is being slowly absorbed.

Among the principal labor developments during the past week, were the engineers' strike in Chicago and the granting of $14 per day to New York structural iron workers, effective July 1.

Engineers and technical employees of the Chicago municipal departments walked out July 1 in an effort to enforce demands for a wage increase of 30 per cent. These demands have been granted in part by the City Council, thus averting a tie-up affecting $10,000,000 worth of construction.

Kansas City, Mo., carpenters unions continue to demand $1.25 per hr., against the old rate of $1.12½; the strike is now entering its third month.

Strike of plumbers at Batavia, N. Y., in effect since May 1, has resulted in a return of the mechanics at the old rate of $1 per hr.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb.	$3.34	$3.40	$4.15	$3.10	$3.35	$3.07½	$3.30	3.35	$4.00
Structural rivets, 100 lb.	4.50	3.50	4.75	3.50	3.75	4.65	5.00	4.00	5.50
Reinforcing bars, ¾ in. up, 100 lb.	3.24	3.30	3.38	2.60	3.25	3.77½	—2.95	3.25	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	48%	54%	53.6%	55%	54.25%	36%	35.6@49.2%	45%	37.83
Cast-iron pipe, 6 in. and over, ton	51.60@53.60	45.30	54.00	49.20@50.20	53.00	64.00	—50.00	55.00	55.00
Concreting Material									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.10	2.32	2.85	2.31	2.65	1.15
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	1.60	1.65	1.90	1.80	1.50	1.50
Sand, cu.yd.	1.00	1.60	2.00	1.40	1.25	1.00	1.40	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.50	2.83	1.87½	1.75	2.50	—1.70	3.00	1.70
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	62.00	34.00	56.00	—40.50	—38.25@38.75	34.75	27.00	23.00	55.00
Lime, finishing, hydrated, ton	18.20	23.50	—18.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl	+2.10@3.00	1.50	1.85	2.25	1.60@1.70	2.70	1.60	2.80	10.00
Common brick, delivered, 1,000	20.40	10.50	14.10	12.00	13.75	12.00	15.00	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.0895	.112	.075	076	.075	.....	.09	.12
Hollow partition tile 4x12x12, per block	.1112	.0895	.112	.075	.076	.075	.108	.09	.10
Linseed oil, raw, 5 bbl. lots, gal.	.89¼	.96¾	1.13	—.89	—.97½	+1.13	.97	1.12	1.03
Common Labor									
Common labor, union, hour	.90⅝	.30	.....	.87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	82½	.45@.60	.40@.45	.50	.50	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Reinforcing bars, billet steel, delivered to job in less than carload lots.

Labor—Concrete laborers' rate, 93¾c.; building laborers, 90¾c.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone f.o.b.; price on fir is quoted instead of pine. Reinforcing bars, billet steel, f.o.b. in carload lots.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. Common labor not organized.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of July 1 the next on Aug. 5.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C.-I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on fir lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 100.09). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½ in., $37.83.

Business Briefs

Call money quoted at 4½ per cent, July 6; year ago 4 per cent.

Time loans: Sixty-ninety days, 4½; four-six months, 4½@4⅝ per cent.

Commercial paper: Best names 4 per cent; other names, 4½ per cent.

On July 1, 1926

E. N.-R. Construction Cost Index Number 207.80

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For Explanation and Details of Indexes Since 1913 See the First Issue of Every Month